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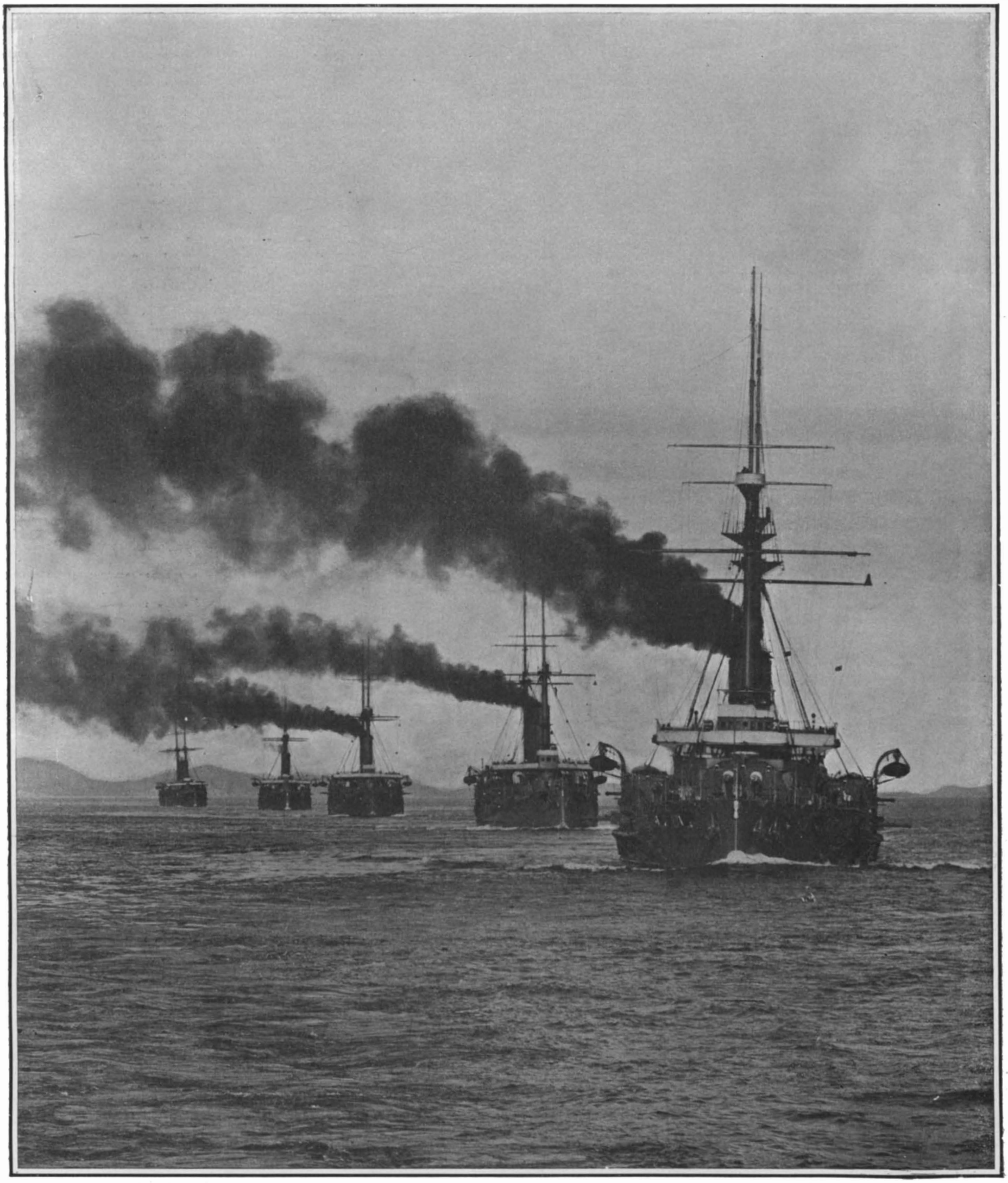
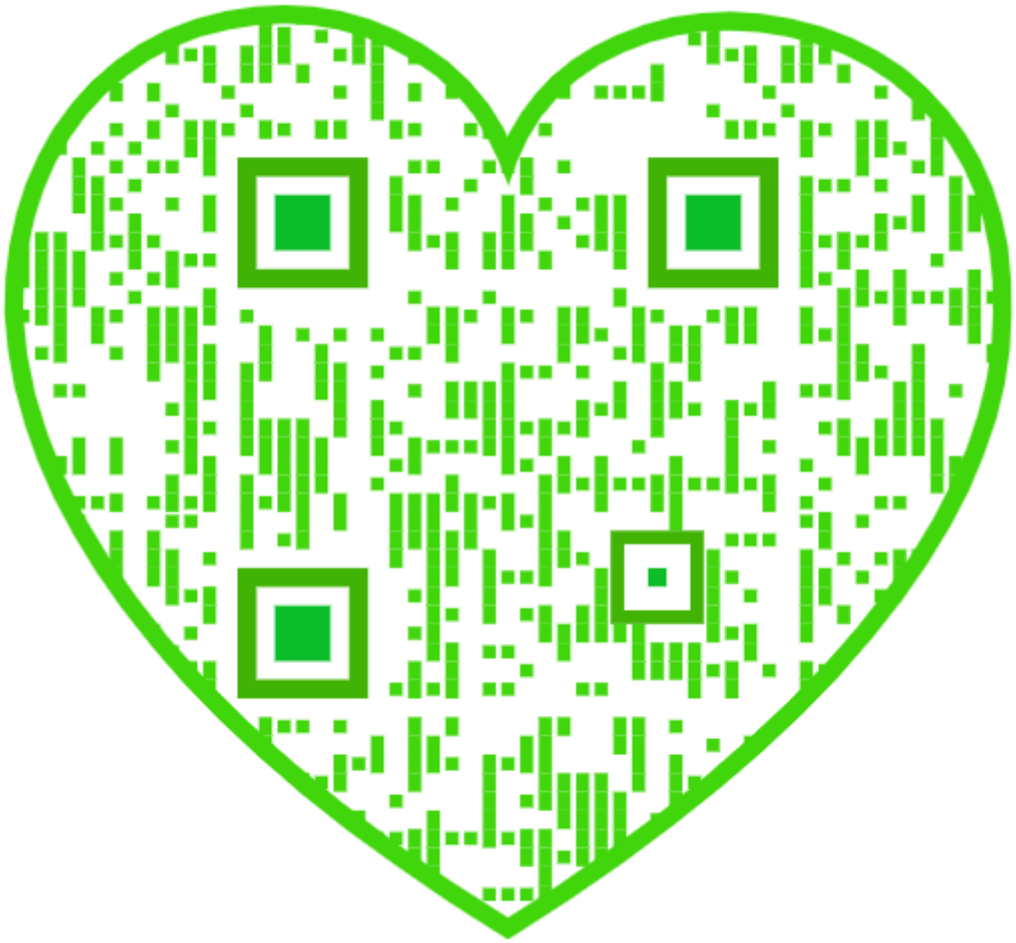


The new 16,400-ton battleship "Katori," with the Crown Prince of Japan on board, entering a Japanese harbor, followed by the armored cruisers "Iwate," "Izumo," "Tokiwa," and "Asama."

V.—THE JAPANESE NAVY OF TO-DAY.—[See page 279.]



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NEW YORK, SATURDAY, OCTOBER 24, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE BALLOON IN FOGGY WEATHER.

The many disasters attending the third international balloon race, which started from a suburb of Berlin, Germany, on October 11, merely emphasized the fact already well understood, that of all forms of locomotion, ballooning is the most uncertain, helpless, and full of peril. Of the 23 competitors that started, four came down in the North Sea, as did two others in the endurance contest of the following day, one of which has not been recovered. The uncertainties of a balloon race were accentuated in the present case by the fact that the prevalence of fog and the shifting character of the wind rendered it difficult, and often impossible, to determine when the balloons were being carried beyond the land. Ordinarily, unless he felt satisfied that the direction, strength, and permanence of the wind and his reserve of gas and ballast were sufficient to carry him across a stretch of water and enable him to make a landing on *terra firma*, a balloonist would be compelled to descend before the limits of the coast line had been reached. In clear weather this can be done with considerable certainty; but in foggy weather, as the sequel of this race has shown, the risks of a disastrous descent into the sea are greatly increased. Humanitarian considerations alone should prevent the repetition of races under such perilous conditions as that held last week; and future races with spherical balloons should be started from some central point, sufficiently far from the seaboard to insure for the contestants a stretch of at least 700 to 1,000 miles before they reach the coast. The city of St. Louis, at which the race of last year was started, was an ideal location. It should be possible to find, say within Central Russia, some city equally well placed as a starting point for such future races as may be held in Europe.

In addition to the risk from thick weather, the race has emphasized another grave peril—that of the bursting of the balloon. Two of the contesting aerostats, one American and one Spanish, ripped open at a high altitude; and had it not been for the fortunate fact that the envelope, in each case, spread out and acted as a parachute, the list of fatalities would have been a large one.

Is it not about time to recognize that the day of the spherical balloon is over? Zeppelin and the Wright brothers have opened a new era in the navigation of the air—an era in which the clumsy spherical balloon has no place.

OUR MACADAMIZED ROAD FIASCO.

The magnificent macadamized roads of Europe are the admiration of all Americans who have had an opportunity to make use of them. Scientifically constructed and most diligently repaired and maintained, they provide to-day, as they have provided in many cases for centuries, a smooth, hard, and well-drained surface, which never varies in its excellence from season to season, or from year to year.

Here in the United States the art of macadamized roadbuilding, at least on a scale of any magnitude, is of comparatively recent date. Such roads as we have constructed have been built, as a rule, under experienced engineers and according to those principles which have been so thoroughly tested in Europe. Generally, our new roads, on their completion, are of excellent quality. The work is so well done that there is no reason why, with proper maintenance, they should not show the same wearing qualities as similar roads abroad.

As a matter of fact, in the majority of cases, our roads, after a single season's wear, begin to show serious signs of going to pieces, and frequently, after two or three seasons' wear, have lapsed into a condition that is little better than that of a common country dirt road. If the top dressing has not disappeared entirely, it will be found in the shape of a deep layer of dust and fine stone at each side of the roadway; the stripped surface will be worn more or less deeply into ruts, or hammered into hollows; and not infrequently the underlying courses of large broken stone and rock will be clearly discernible.

Why do American macadam roads go to pieces so swiftly, while those in Europe maintain their fine surface indefinitely? The answer is to be found in the fact that in Europe they have a careful system of road maintenance, and in the United States we have none, or practically none. European roadbuilders and supervisors, or whatever they may be called, clearly understand that there is no engineering work that depends more absolutely for its integrity and permanence upon careful attention and upkeep than does a macadamized highway. They understand, moreover, that there is no work of the kind in which the old adage, "a stitch in time saves nine," is more true than in this; and, consequently, their system of road maintenance involves a constant and careful inspection, and the immediate repair of any spot in the road, however small, that shows incipient signs of breaking down. Hence the work of keeping up the European roads is being done all the time; in many places; and by a large army of individual laborers. The solitary road repairer, with his wheelbarrow, pick and shovel, and little pile of broken stone and top dressing, is a familiar sight. It is his duty to inspect daily his own section. On detecting a low spot where water might collect (the genesis of the American "chuckhole"), he makes immediate repairs.

Here, in the United States, we know little or nothing of such road maintenance as this. No sooner is a stretch of new road accepted and paid for, than it is left to the tender mercies of the traffic and the weather. Incipient ruts and hollows, instead of receiving the immediate care of the road mender, are allowed to remain full of the standing water of the last rainstorm, and are quickly deepened and widened by the wear of the passing traffic. When the work of destruction has proceeded unhindered to a certain stage of ruin, the road is given a wholesale repair (*sic*) by dumping upon it a few hundred tons of top dressing, which is left to be crushed down into the irregular and ragged surface beneath by such haphazard rolling as may be given by passing traffic.

In the present campaign of "good roads" education, more attention should be paid to the vital function of road maintenance. Our present practice of building a first-class road and then letting it go to ruin as fast as wind, weather, and traffic can wreck it, is the height of folly and extravagance.

FLAREBACKS IN THE FRENCH NAVY.

The "flareback" peril is not, by any means, confined to our own navy. The recent disaster on the French ship "Couronne," due to this cause, when twenty-seven lives were lost, has been followed by a similar accident on the "Latouche-Treville," in which nine men were killed. In discussing the accident, Le Figaro of Paris says that the committee of investigation ordered to look into the explosion on the "Couronne" attribute the accident to a "retarded inflammation of the gases developed by previous charges." Two hypotheses were offered in explanation of the explosion. First, the ignition of the powder in the bore of the gun, either spontaneously or through the heat of the bore or of the residues at a high temperature; and second, the blow of the breech block against the cartridge case in closing the breech. In either case, the projectile, offering a certain resistance to expulsion, remained in its seat, while the breech block—closed but not yet locked, and consequently offering no resistance—was thrown back and broken, leaving a free exit to the gases escaping from the cartridge case. These gases set off two other cartridges that the gun's crew held in readiness, and thus burned the personnel. These are the facts as found.

The artillery officers, standing on experiments made at the Servan-Livvy laboratory and the Gavres firing ground, maintained that the primer had been exploded by the shock of the breech block against the head of the cartridge case. They based their conviction on the fact that such an explosion had been brought about by tests that had been most carefully supervised. The naval officers did not deny this; but they maintained that such an explosion was only produced by repeated blows of the breech block against the cartridge case, and never on a first blow. In addition, they maintained that, on the evidence of the survivors, this had not been the case in the accident of August 12. Furthermore, the reports on the incidents of the target firing on the "Gueydon" in 1904, with her 6½-inch guns, model 93-96, that is to say, the same model as those of the "Couronne," show that the phenomena occurring at that target exercise were identical with those marking the accident on the "Couronne"; and the cause as reported on investigation was attributed to a retarded reinflammation of gases developed by previous firing, the flame being communicated to the powder exposed bare in the cartridge case, as the latter is left entirely open in front.

This proof, sustaining the contention of the naval officers, was singularly confirmed very shortly afterward by other incidents equally significant which occurred on board the "Justice." In one of the 12-inch turrets of this battleship, just as the last part of the cartridge had been inserted in the chamber, a sheet of flame burst back; fortunately, the web of the cloth of which the cartridge bag is made resisted the flame, but it was only thanks to this that no accident happened. Again, and a few days afterward, on one of the armored cruisers, just at the moment when the breech block of a 6½-inch gun—identical with that of the "Couronne"—was closed *and locked*, the gun went off; one second sooner, and the accident of the "Couronne" would have been exactly repeated. In face of this assemblage of concurring facts, it was considered to be no longer possible to deny the existence of the flareback, that is to say, the retarded reinflammation of gases engendered by prior discharge, as the cause of the accident on the "Couronne." There is more doubt as to the cause of the "Latouche-Treville" accident; although the balance of evidence seems to point to the detonator having been struck prematurely as the cause of explosion.

MANUFACTURING PAPER FROM CORNSTALKS.

The chemists of the United States Department of Agriculture have at last solved the problem of how to turn into paper the millions of tons of cornstalks wasted annually. After years of experiment, the department now reports that the vast quantity of material heretofore considered valueless and destroyed every year by the farmers of the country can be utilized, thus saving much of the remaining wood reserve of the United States, and bringing about the manufacture of paper from an annual crop.

The first practical samples of this new paper were manufactured in Washington, and consist of five grades in five colors. One grade is dark gray, thick and heavy, resembling parchment. There is a lighter grade of the same character, two shades of yellow and one of white. The latter are manufactured from the hard outside part of the cornstalk, and the former from the interior or the pith. The yellow grades have much longer fiber, and resemble paper made from cotton rags or linen, being soft to the touch and pliable, and appearing to have been made from material of entirely different character from that used in the gray product.

In the process of the experiments which resulted so successfully, the "soda-cooked" method was employed. This process many manufacturers of paper have found to be the best treatment for the finer grades of wood-pulp paper. The cornstalk pulp can be cooked in from two to two and one-half hours, as against twelve to fourteen hours needed in treating wood. It is claimed that even at the present primitive stage of experimentation, cornstalk paper can be made almost as cheaply as wood-pulp paper, though the latter industry has been developing for the past half century. The belief is freely expressed by the scientists who have been conducting these experiments, that when proper machinery is brought out, and the farmers grow cornstalks in localities where they can be moved cheaply to the mill, the cost will be fully fifty per cent less than paper now manufactured from wood. At the present period, with wood at $8 a cord, it costs $13 to manufacture a ton of wood pulp. With cornstalks at $5 a ton, and adding the cost of bringing the stalks from nearby farms to the laboratory of the Department of Agriculture at Washington, pulp can be manufactured at $14 a ton. These figures are looked upon as prophetic of the future, no new product ever having been produced in the past at anything near the price reached subsequently with commercial development.

No special growth of corn is required, as the experiments have shown that any kind will answer the purpose of manufacture. The kind used, however, was the common Virginia and Maryland field corn, but that grown anywhere will do as well. The discovery is undoubtedly one of the most important of its kind made in recent years, as it will add millions of dollars to the income of the farmers, and partially reduce the drain on the forests of the country, besides furnishing an equally good and a much cheaper paper than can now be manufactured from wood pulp.

The French automobile export business continues to decline. The exports for the first five months of 1908 amount to $10,738,200, compared with $14,219,800 in 1907. The only countries showing an increase are Russia, from $121,200 to $340,000; Turkey, from $10,800 to $78,800; Algeria, from $292,200 to $428,200. All the others show decreases, America falling from $912,600 to $903,000.

ENGINEERING.

A dispatch from the torpedo station at Newport speaks of the shortage of torpedoes in our navy as compared with that of other leading powers. The United States has on hand about 500 Whiteheads as against 4,000 credited to Germany, a similar number to Japan, and 10,000 to Great Britain.

The British battleship cruiser "Inflexible," which carries a battery of eight 12-inch guns, is said to have attained a speed of 27¼ knots during her recent trials, exceeding the trial record of the sister ship "Indomitable," which subsequently to her acceptance made the run across the Atlantic at a speed of slightly under 25 knots an hour. The Parsons turbine, with which the "Inflexible" and "Indomitable" are equipped, is certainly winning great distinction just now, both in the navy and the merchant marine.

Upon being shown a statement, made by Congressman Tawney before the Fire Underwriters' Association of the Northwest at a meeting in Chicago, to the effect that the Panama Canal would be completed in six years, at a total cost of $256,000,000, Col. Goethals, the chief engineer of the canal, who is at present in this city, verified the statement, asserting that he expected the canal to be open for navigation by January 1, 1915; and that unless some unforeseen contingency arose, the total cost would not exceed the sum named.

The omnipresent automobile was pressed into a new field of service the other day, when the printing plant of our esteemed contemporary, the Bloomfield Citizen, broke down, owing to the failure of the gasoline engine. The accident occurred during the running of the regular edition, and emergency repairs were out of the question. The timely arrival in his automobile of a friend of the editor solved the problem. The automobile was backed up to the rear door of the printing office, suitable connections were made from the engine to the cylinder press, and the edition came out only a few hours late.

Evidence of the severity of the present drought is shown by the conditions of navigation on the Ohio River, where there is not sufficient depth of water for the passage of light-draft vessels. It was officially reported at the beginning of the present month, that the water level at Cincinnati was only one foot above the lowest recorded stage, and that it was still falling on that date. On account of the low water, the United States Lighthouse Inspector has given orders that none of the river lights between Pittsburg and Chicago be lighted, something which has not occurred for a period of twelve years.

The new United States derelict destroyer "Seneca," which is receiving her finishing touches at the Newport News shipbuilding yard, will shortly be placed in service on the Atlantic coast, where she will keep the waters clear of derelicts from Bermuda to Sable Island. The headquarters of the "Seneca" will probably be at Tompkinsville, Staten Island. Arrangements will be made by which any incoming or outgoing ship, upon locating a derelict, may communicate the fact by wireless telegraphy. It is to be hoped that the success of this venture, concerning which there cannot be any doubt, will lead the other maritime nations of the world to build similar vessels for safeguarding those routes of travel which lie within their several jurisdictions.

The recent launch of the "Laurentic" by Harland & Wolff for the Liverpool-New York service of the White Star Line, was of more than ordinary interest to marine engineers, because of the fact that in this ship will be tried for the first time on a transatlantic liner, a combination of reciprocating and turbine engines. The ship is 565 feet in length and of 14,500 gross tons. Her motive power operates three propellers; two in the wings are driven by reciprocating engines, and one in the center by a turbine. The steam will be expanded down through the upper ranges in the reciprocating engines, and from them will exhaust at from 8 to 10 pounds pressure into the single low-pressure turbine, from which it will pass to the condenser. By this dual arrangement the maneuvering qualities of the reciprocating engine are combined with the steam economy of the turbine.

Apropos of our editorial in the issue of September 26 on the weight of passenger cars, a recent article in the Electrical Railway Journal on the same subject will be of interest. The data showing the relation of car weights to seating capacity include forty-six different cars, chiefly those designed for interurban service. Most of them weigh from 1,200 pounds to 1,333 pounds per seat, with a total seating capacity of from forty to seventy-one. The range of variation of weight is great. One interurban car seating sixty passengers weighed only 854 pounds per seat; another of the same capacity weighed 1,213 pounds per seat—a difference of dead weight per passenger of 42 per cent. The lightest car is a city box car weighing 625 pounds to the passenger, and the heaviest is a steel motor car weighing 1,600 pounds to the passenger, the latter seating sixty-four, and the former twenty-eight.

ELECTRICITY.

The total number of passengers carried by the railroads of New York State during the six months from July 1 to December 31, 1907, according to the Report of the Public Service Commission, was 1,630,775,156. Of this number steam roads carried 105,757,957. The rest were carried by electric elevated, surface, and underground lines.

A new electric locomotive is being used on the Puget Sound Electric Railway. It consists of a combination locomotive and flat car. The mechanism is placed under the floor of the car, leaving space for carrying rails, poles, and any apparatus that may be required in the repair of the track. The cab of the locomotive is placed in the center of the car and extends across the entire width. The cab is raised sufficiently so that the motorman may have a clear view of the track over the materials carried on the car.

It has often been observed that when looking at red and blue objects, the red one appears nearer than the blue. Writing in the current Quarterly of the United States Naval Institute, Dr. J. H. Clayborne calls attention to this phenomenon, and suggests that white electric lights be utilized for signaling on ships and lighthouses. The port and starboard sides of the ship could be differentiated by arranging the lights in different formations. Different lighthouses could be identified by the arrangements of their lights, and the size and shape of the arrangement would give more positive information as to the position of the lighthouse in respect to the danger point.

Wireless telegraphy as applied to military purposes has been tested at the maneuvers conducted at Atascadero, San Luis Obispo County, Cal., under Col. Marion T. Mans, U. S. A., commander of the Department of California. The signal corps was provided with portable instruments which were transported on the backs of mules, and they endeavored to keep in touch with the headquarters at the various distances across all conditions of country. The apparatus carried by the signal men operates inductively and requires no direct ground. It can be unpacked and set up in twenty minutes. The maximum range is 25 miles, but this can be increased by using a longer mast and a grounding system to 135 miles.

Shifting of trains is carried out with great simplicity by means of the new electric locomotive which has been installed for the purpose at Berlin in the Tempelhof yards. The locomotive is built specially for use in depots or locomotive yards and uses a storage battery, being thus quite independent. There are two electric motors, one on each axle, which give 20 horse-power each, or 40 horse-power for the entire locomotive. A potential of 300 volts is employed at the terminals of the battery, and there are 160 cells. During a series of practical tests which were made with the locomotive it was shown that the working speed was 7 feet per second, and the weight of the train varied up to 200 tons. The mean weight of the trains was 60 tons. The voltage of each cell is 2.45 volts at the charging and 2.09 volts on the discharge.

From time to time efforts have been made to use wireless telegraphy for distributing time signals from a central clock to the electrically controlled clocks over a wide area, but these efforts have been unsuccessful because of the disturbances due to other wireless systems, as well as atmospheric electric waves. However, an Austrian inventor appears to have solved the problem quite ingeniously. His central clock sends a signal only once every sixty seconds and the clocks to be controlled are provided with apparatus which will receive the Hertzian waves for that second only while for the remaining fifty-nine they are unaffected by any Hertzian waves. In case of a disturbance during the one second when they are in circuit with the receiver the disturbing wave may set the clock incorrectly and for the next minute it will be a fraction of a second fast or slow. However, this inaccuracy will be corrected by the master clock a minute later, when it is again placed in circuit with the receiving apparatus.

The maximum voltage of underground transmission systems has kept at about one-third that of overhead lines. The reason for this, and also the possible limitations for underground transmission, were discussed in a paper read before the American Institute of Electrical Engineers last week, by Messrs. P. Junkersfeld and E. O. Schweitzer. They sum up as follows: That underground cable systems of 11,000 volts and under if properly laid will give at least equal and probably more reliable service than most of the other elements of the system of which the cable is part. That where local and commercial conditions justify pressures as high as 25,000 volts, such a potential can safely be used for as much as 100 miles of cable, but that no single line of the system should be longer than 20 miles. On comparatively short lengths underground or underwater as a part of the overhead transmission line, cables operating at 40,000 volts can be used.

SCIENCE.

Prof. Edward Hull, F.R.S., whose studies of ancient river channels in the ocean bed have formed the subject of several interesting papers, has communicated to the Royal Geographical Society of Great Britain the results of his latest investigations in this field of research. By analyzing the Admiralty soundings he has succeeded in tracing the submarine bed of the River Adour and the Fosse de Cape Breton for a distance of about 50 miles out to sea, at which point it opens out on the floor of the ocean at a depth of 1,500 fathoms. He has also devoted considerable attention to the submerged valley of the Congo. Another scientist had previously traced this out from its upper limit, where it enters the Atlantic, to a distance of about 80 miles. Prof. Hull, however, has succeeded in carrying the channel a farther 20 miles out to sea.

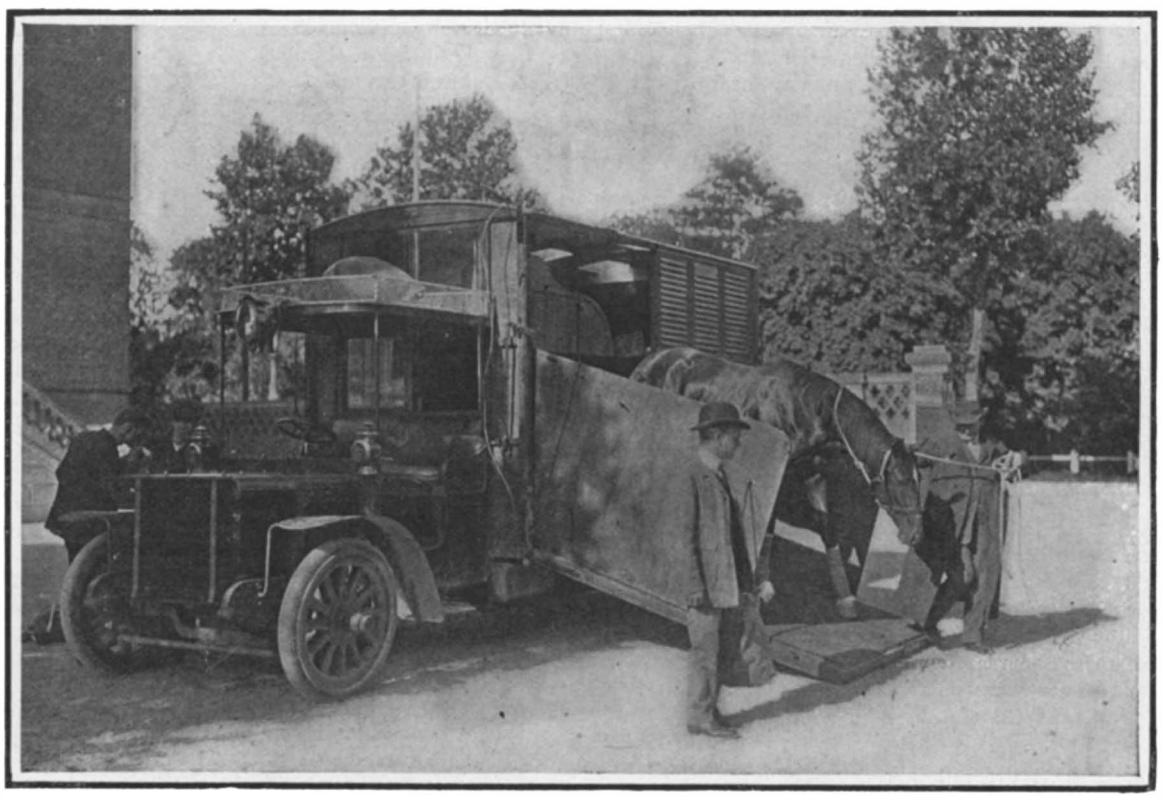
Upon the new observations of Prof. Hale, made at Mount Wilson, Cal., on the double lines in sun-spot spectra, Prof. Zeeman bases a theory that sun spots are strong magnetic fields. The source of light in a magnetic field emits two rays circularly polarized in opposite directions and parallel to the lines of magnetic force, according to Prof. Zeeman's experiments. The sun-spot lines photographed by Prof. Hale are identical in character with these lines. Hence Prof. Zeeman's conclusion. To produce the actual phenomena observed on the sun would require a current of about 5,000 amperes. The theory throws a great light upon meteorological and terrestrial magnetic phenomena, affording, as it does, some reason for the perturbations observed in the electric and magnetic equilibrium of our earth and its atmosphere. In order to account for the force which converts a sun spot into a magnetic field, Prof. Hale assumes a segregation of positively or negatively electrified particles caught in the stream of a solar vortex, so as to give rise to lines of magnetic force at right angles to the plane of the swirl.

The question, can fish distinguish colors, has often been asked, but has never been very satisfactorily answered. Dr. David Starr Jordan, president of the Stanford University, states that it has been assumed that fishes can distinguish colors to some extent, but the only basis of that supposition has been the fact that the fishes in their breeding season are often brightly colored, and that males and females are often of very different colors. Two sets of experiments have recently shown that fishes can distinguish colors; one of these experiments was made at the University of Michigan, and showed that with the "rainbow darter," a brilliantly-hued little fish of the Michigan brooks, the bright-colored males with blue and red frighten the younger males by the display of these colors. It has also shown that the young males colored like the females are not distinguished by the full-grown males from these, so that the sexes seemingly know each other by the brilliant colors of the full-grown male. Another set of experiments are those of Prof. Jacob Reighard, also of the University of Michigan. In the tropics he has taken the "silver side," and painted it different colors, and he finds that the predaceous barracuda sees certain colors much more readily than others, and quickly snaps at objects that are brightly colored. The prevailing silver-green colors of the living fish are best adapted to escape the attention of the larger fish, and thus, to some extent, their wearers enjoy an immunity from destruction.

A Javanese subscriber of this journal, Mr. Bruysman of Nongho Djadjar, near Lawang, Java, sends us an interesting communication on a botanical garden which he established in 1907 at an altitude of 4,000 feet. The climate, he writes, is ideal. Even the wet season lasting from November to April is not too unpleasant despite the daily rains. The temperature is fairly constant, fluctuating from 65 deg. in the morning to 80 deg. at midday. Water is plentiful even in the dry season because of the innumerable mountain springs. In his experimental botanical garden Mr. Bruysman is growing hundreds of tropical, European, Asiatic, American, and Australian plants, his purpose being to collect medicinal, ornamental, and useful plants from all quarters of the globe. In attaining that purpose he has been assisted by many botanists, and asks that the readers of this journal help him in his work by sending seeds and specimens. He finds that many European plants flourish better in his garden than in their native habitat. During the rainy season (a very critical period for any botanical experiment of such magnitude) he carries on by far the greater number of his studies, because plants which resist its heavy moisture may be regarded as acclimated. It is impossible to mention in a brief note all the plants he has studied or to condense in a few lines the results of his elaborate experiments. Suffice it to say that his plants include most of the commoner forms known to Europe and America. Mr. Bruysman writes that he will be glad to furnish gratuitously seeds or roots of medicinal plants in his garden for purposes of experiment to readers of the SCIENTIFIC AMERICAN.

AN AUTOMOBILE FOR HORSES.

The automobile has surely been placed to no more ironical purpose than that which we herewith illustrate. A French manufacturer has devised a conveyance which is actually intended for the transportation of the very animals which the automobile is intended to supplant. Seriously considered the vehicle has certainly much to commend it. As the reader no doubt suspects, it is primarily designed for the conveyance of valuable racing horses, that cannot be intrusted to a railway without some anxiety. An accident might mean a heavy financial loss to the owner of a horse. In an automobile such as that herewith illustrated a thoroughbred can be transported with considerable safety, and besides, with far more convenience and comfort. The interior of the vehicle is fitted up as a stable with all the requisites to which the pampered horse is accustomed.



AN AUTOMOBILE FOR HORSES.

ORIGINAL METHOD OF MAKING A RAILROAD FILL.

To enable the new Western Pacific Railway to reach the main water front, where its principal terminal will be located, it was necessary to build a fill across a tide flat extending out from the southern arm of San Francisco Bay. The total length of the fill is not great, being about 750 feet, and the height of the finished grade above the flat is 35 feet. Owing to the soft nature of the bottom, however, it was necessary to dump a large amount of rock into the mud, in order to secure a solid foundation. In some places the submerged rock sank to a depth of fully 40 feet, and in such places the total height of the fill is 75 feet. To have laid the fill by dumping from a temporary trestle would have been both difficult and expensive, and consequently the contracting firm devised the ingenious method shown in the accompanying illustration. Two suspension cables, each 2 inches in diameter, were strung parallel with the axis of the fill, each cable being about 900 feet in length. They pass over wooden towers built of 14 x 16-inch timbers strongly braced together, and are firmly anchored in the ground. The construction tracks are laid in the usual way upon the completed fill; but where the end of the dump is reached, the track is continued over the tide flat and supported from the two cables by means of short lengths of 1½-inch cable, a sufficient stretch of track being hung in this manner to allow three 10-ton dump cars to be run out beyond the fill at a time. When the fill has been brought up to grade, the suspended tracks are imbedded upon it, and a fresh length of track hung upon the cables.

As far as we know, this method of construction is entirely original; and it serves to show that in the heavier engineering works there may yet be room for many improved methods, even in such standard work as that of building an ordinary railroad fill. The credit for the design of the suspension system of dumping is due to the Western States Construction Company, who are making the fill with rock excavated from an 1,800-foot tunnel, which the company is boring for the Western Pacific in South San Francisco.

An interesting investigation has recently been started at the Manchester University kite station at Glossop, the object being to determine the electrical conditions of the upper atmosphere. It has long been well known that the air at some distance above the ground level is at a relatively high potential. The observations, however, have not up to the present been extended to any considerable altitude. The experiments are being carried out at Glossop in the following way: A kite is sent up attached to a steel wire which is anchored down to the ground by means of an insulator. The potential difference is first determined, and then the wire is connected to earth through a galvanometer, which measures the current.

A union railway station is now in the course of construction at Leipzig, Germany, which will be one of the largest in the world. The five terminal stations which are in Leipzig at the present time will all be removed upon the completion of the new terminal. This latter is to have 26 parallel tracks which will accommodate the trains of 13 different lines, and between each pair of tracks is to be a walk 40 feet wide, so that the total width of the train shed will be nearly 1,000 feet. The main façade of the building will be 1,115 feet wide, or over 350 feet greater than the facade of the new Union Terminal at Washington, D. C., which is at present the largest in this country.

Water Sterilized at the Tap.

Ozone is one of our most powerful oxidizers, and advantage has been taken of this fact in a novel manner in France. Drinking-water, though passed through a lengthy cycle of filtering and purifying operations, may be extensively contaminated by microorganisms. The latest development is the introduction of a certain quantity of the gas into the water at the tap, so that when drawn the liquid is to all intents and purposes perfectly sterile. The apparatus is very simple and inexpensive to install. Mounted on a small panel some fifteen inches square is a small ozonizer, comprising sheets of glass covered with tinfoil on one side, and freely perforated. A current of air is drawn through these plates, which is ionized under the influence of the electric current. The ionized air passes into an inverted glass bulb into which the water is thrown by the main pressure in the form of a spray, and accordingly it combines with the gas, which immediately seizes upon all bacteria present, oxidizing or dispatching them immediately. The water drawn from the tap is quite germ-proof, while the addition of the ozone imparts a delightful sparkle and an invigorating taste to the liquid. The apparatus is very economical in operation, the ozonizer merely being connected to the holder of an electric lamp, while the simple task of turning the tap sets the ozonizer in action, switching off the current when the supply is arrested. The electrical consumption is very small, one unit sufficing for the sterilizing of a thousand gallons of water. Over a thousand of these sterilizers have been installed in private houses in Paris, and recently they have been introduced into this country. The system has also been extended to the purification of public supply installations, a huge plant having recently been completed for the sterilization of the drinking water of Nice before its entry into the distributing mains, a plant capable of treating over five million gallons of water per day.

Several recent railway accidents in Germany have been traced to the failure of engine drivers to see signals, which circumstance has caused the Prussian railway administration to adopt a new signal apparatus. The feature of the new system lies in the warning given the engine driver that he is approaching a signal about 110 yards before the signal itself is actually reached. This is accomplished by the use of an electric cab signal system, which arouses the driver's attention by ringing a bell and exposing a white slide directly before his eyes in the cab. With his attention thus stimulated the driver will have no excuse for running by a signal in a fog.—Railway Magazine.

NEW METHOD OF MAKING A FILL BY DUMPING THE LOADED CARS FROM A SUSPENDED TRACK.

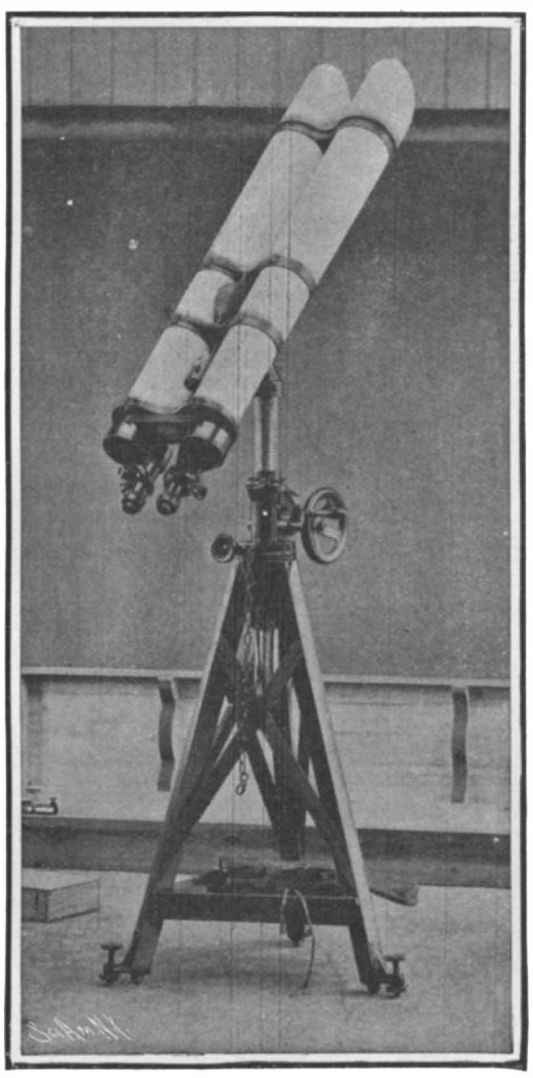
THE MOUNTAIN TELESCOPES OF SWITZERLAND.

BY HAROLD J. SHEPSTONE.

During the last few years there have been erected at the termini of the mountain railroads of Switzerland and at other suitable lookout stations some exceedingly powerful long-range observing telescopes. They are at once rendered conspicuous by their construction and size, and have rightly become very popular among tourists for the reason of the splendid panorama views of the mountains obtained through them. Indeed, the ordinary traveler is often dumfounded with the wonderful detail that is brought out through these high-power glasses.

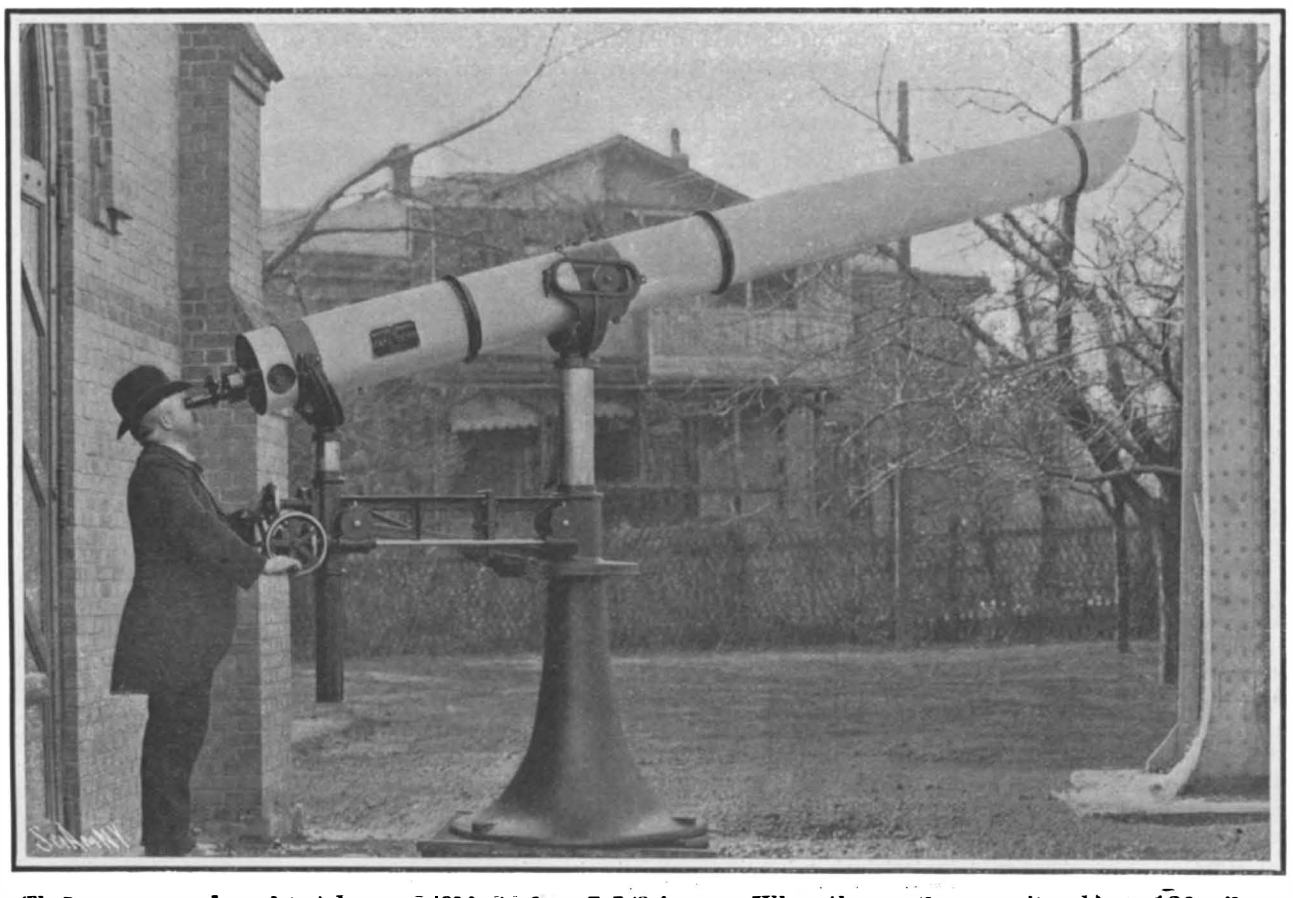
The idea of establishing telescopes on the mountains of Switzerland was indeed a happy one. Not everybody has the inclination or the necessary physical strength to undertake arduous climbs in this mountainous land, and so obtain a close glimpse of this wonderful world of ice and snow. True, there are now a number of mountain railroads penetrating right into the heart of the Alps, but even these are not accessible to all. Many lack the time or even the means of availing themselves of these ingenious railroads up the hillsides; but the tourist can now study the rocks and glaciers, and note the formation of the summit of Europe's most famous range of mountains, by the simple operation of viewing them through a telescope.

Naturally, the variety of mountain scenery in Switzerland offered a unique field for the introduction of a telescope suitable for long-range observation. It was necessary, of course, to turn out a glass which could be used by the general public without difficulty. What was demanded was an instrument free from chromatic aberrations, one offering a large field of vision, through which one could observe with ease a bright and clear section of the landscape. All these conditions are more than fulfilled in the telescopes which have been specially constructed for use in the Swiss mountains by the well-known optical firm of Carl Zeiss of Jena. It was in these instruments that the new Jena glass was practically used for the first time.



A Stereoscopic telescope which preserves perspective values.

Watching a climber on the Matterhorn through a 5 1/8-inch telescope on the Riffelalp, Zermatt.



The long-range observing telescope. Object glass, 7 7/8 inches. When the weather permits, objects 120 miles distant can be seen clearly.

This new type of telescope may be roughly divided into two classes, monocular and binocular; i. e. those through which the observation is made with one eye only, and those through which it is made with two. The former are mostly fitted with a revolving appliance, the simple turning of which allows of rapid change of magnifying power. The telescopes seen in our photographs possess object glasses 5⅛ inches in diameter, and magnify 35, 58, and 116 times respectively. The binocular instruments are contrivances astonishing in their effect. It is well known that our power of perspective rapidly decreases as the distance from the object increases. The reason for this is that the optic angle at which objects appear decreases with the distance, and finally becomes so slight that we lose all power of estimating it. We can, however, enlarge this angle by approaching the object, or by bringing the object apparently nearer to us, or ultimately by increasing the distance between the eyes. The optic angle is the angle formed by two straight lines from our eyes to a given or observed point. It is quite clear that to extend the distance between the eyes an artificial medium is necessary, and this train of ideas is realized in the binocular telescope under notice. Imagine, for instance, the two object glasses of an opera glass 25 times farther apart than the normal distance (about 2½ inches) between the eyes, that is 5 feet, and the projected image again reduced to normal distance by inserting prisms; the object would then appear at an optic angle 25 times as great. Now suppose we view a landscape two miles distant; the separate objects—houses, trees, people, etc.—would appear to us as if only 140 yards away. Now apply, in completion of the instrument so constructed, ocular glass of tenfold magnifying power, and we raise the plastic or stereoscopic effect proportionally, we achieve a 250-fold plasticity, and the objects appear as if they were only eighteen yards away. This is the principle of the latest mountain telescope. Upon everyone who is able to see stereoscopically it produces a most striking effect; mountain chains, precipices, etc., which, when seen through an ordinary telescope, are apparently on the same plane, separate from one another in a most surprising manner. The observer sees before him a living stereoscopic picture, sharp cut, clear, and in glowing natural colors. He sees the trees stand forth, the rocks recede; the foreground appears pushed quite up to the front, and the observer is made to believe that he is looking into the country from an elevation. Especially in the mountains does this panoramic effect exercise its magic.

At both the objective and eyepiece ends of the telescope are cap arrangements for protection against rain or wind. The telescope rests in a forked cradle, is well balanced, and can be clamped in any position by tightening thumb screws. The elevating gear is a simple but very complete contrivance. By means of hand wheels the eyepiece can be so adjusted as to remain focused on objects of varying altitude above the horizon. Indeed, the instruments are the envy of many an observatory. Their magnifying power, which is adapted only for landscape observations, not for astronomical observation, ranges from 35 to 116 diameters; even the lowest of these, the one mostly employed, gives extraordinary results.

Through the instrument at Uetliberg near Zürich, for instance, climbers on the Titlis, 40 miles distant, can be seen on a clear day, the atmospheric conditions being favorable. The hotel on the Faulhorn, 60 miles distant, can be recognized with this instrument, and in very fine weather the small trigonometrical signal itself, as well as visitors on the Rigi, the crevasses in all visible parts of the Alpine chain, and one of the church clocks in Shaffhausen, may be seen. Through the instrument on the Riffelalp above Zermatt, the movements of the Matterhorn climbers may be as clearly followed as if they were within hailing distance. One sees them cutting steps in the ice, carefully placing their feet therein, and paying out the

rope. On such a day the telescope is much frequented. Through the instrument on the Schynige Platte near Interlaken, the timid chamois may be observed on the precipices miles distant, as they are otherwise never to be seen, and persons on the four miles distant Faulhorn are easily distinguishable. All the great ascents are now watched through the telescopes, and anxious relatives can follow their friends' progress up the mountains. Then again these wonderful instruments have often been the means of saving life. Accidents have been witnessed through them, and help dispatched to those in danger. The signals of distress from the Alpine guides are invariably first seen by the watchers through these powerful glasses.

Similar instruments are to be found on the Rigi, the Weissenstein near Solothurn, the Wengeralp (Scheidegg), and on the Jungfrau railway; in Bern, Grindelwald, Zermatt, and other places. The object glass in almost every instance is 5⅛ inches in diameter. Naturally, such instruments are expensive, as they represent the very best and latest of their kind. The telescope on the Schynige Platte, for instance, cost $460. It is interesting to note that the Carl Zeiss firm is now turning out a long-range observing telescope with a 7⅞-inch object glass. This will magnify objects 60, 100, and 200 times respectively, and in the clear atmosphere of the Swiss mountains, one should be able to see an exceptionally long distance with it.

Tapping the Earth for Electricity.

BY PRIVY COUNCILOR OF MINES TECKLENBURG.

As pure water, mineral waters, petroleum, gas, and heat can be obtained from deep borings it appears worth while to make an attempt to obtain electrical energy from the interior of the earth by the same means.

I have already published numerous instances of the magnetization of driven well tubes. Some tubes, driven less than a thousand feet into the earth, became magnetized strongly enough to sustain the weight of large iron keys placed in contact with the protruding tops of the tubes.

We know, furthermore, that a measurable electric current is generated when two electrodes, connected by a wire, are immersed in solutions of different temperatures or different degrees of concentration. Now the earth contains various liquids, the pressure and temperature of which increase according to their depth below the surface. This distribution must produce electric currents and these may possibly be the most available subterranean source of electric energy, for to every depth corresponds a certain constant pressure and when this pressure is removed (as by a boring) the temperature immediately rises.

In the universe in general, very great electrical tensions are produced, in all probability, by various periodic cosmical influences. In the atmosphere we observe a continuous variation of electric charge and potential, and as the electric charge of the earth depends chiefly on the electricity of the air, it should undergo violent, though momentary, disturbance in thunder storms, especially near the striking point of a discharge. It is well known, also, that the electrical state of the ground always differs from that of the air.

There are, no doubt, electrical currents in the earth, caused by local differences in electrification, as winds are caused by differences in atmospheric pressure. If the interchange of electricity represented by these earth currents could be made to take place through suitable apparatus it would become an available source of energy. The regular alternation of solar illumination probably generates earth currents of unvarying direction, analogous to the trade winds and other constant air currents produced by the same cause. Certain solar phenomena, including increase in the number, size, and variability of sun spots and faculæ, and the formation of protuberances and eruptive columns of incandescent gas, strongly affect the electrical and magnetic condition of the earth. The aurora borealis is undoubtedly of electrical origin. The earth currents due to solar influences and the rotation of the magnetized earth must be influenced by variations in the electrical state of the atmosphere. Telegraph and other electrical circuits, both overground and underground, are affected by earth currents, especially during auroral displays, when it is often impossible to telegraph for hours.

The considerations set forth above suggested to me the following experiments, which were conducted in borings miles distant from underground electric circuits.

The first boring was unlined, had a depth of only 46 feet and was filled to a depth of 11½ feet with water. The second boring was 184 feet deep, contained 131 feet of water and was lined with iron pipes to a depth of 151 feet. The apparatus consisted of a brass rod, a lead cylinder 6 inches long and 2 inches in diameter, about 300 feet of insulated copper wire, and an amperemeter and a voltmeter, which were placed in a building near the shaft.

When the lead cylinder was lowered into the shallow and unlined boring, the brass rod driven into damp ground 150 feet from the mouth, and the two connected through the galvanometers by means of the insulated wire, the instruments indicated 0.06 volt and 0.001 ampere. The substitution of a number of brass screws for the lead cylinder raised the voltage to 0.16, and the substitution of an iron pipe for the brass rod raised it to 0.24 volt, but in both cases the current remained equal to 0.001 ampere. Experiments made in the deep boring gave substantially the same results when the suspended electrode was sunk to depths of 130 and 160 feet, though distinctly greater deflections were obtained at the full depth of 184 feet. Depths of several thousand feet may, of course, give very different results.

It would be an easy matter to lower electrodes to various depths in wells, mine shafts, and other borings and excavations. Unfortunately I cannot do this myself, as I do not control the shafts, but contractors and mining companies might well take up the problem. It would only be necessary to place a hollow copper cylinder, 60 feet or more in length, at the bottom of a boring of 3,000 feet and to connect it by a well-insulated copper wire with a similar cylinder buried in moist earth at the surface in the vicinity of the mouth, intercalating a voltmeter and an amperemeter at any convenient points. Possibly a current strong enough to charge an accumulator might thus be obtained. Perhaps a strong current can be obtained merely by connecting an electrode buried in moist earth with the top of an iron well pipe of great length. The simple expedient of connecting two neighboring pipes at mineral springs might conceivably furnish a current, and is well worth trying. If the pipes are of different metals, iron and copper, further experiments should be made with pipes of the same metal in order to distinguish the galvanic from the earth current.

Experiments of many kinds, indeed, should be made in deep borings, if only for the sake of the possible utilization of many costly borings that have been abandoned. No doubt other and better methods than I have suggested will be found for obtaining electrical energy from the interior of the earth. I merely wish to induce others to repeat these experiments in deep borings and mine shafts and I shall be glad to assist in the work.

What is to be expected of such experiments? In the most favorable case we may find in the depths of the earth sources of heat, light, and power of vast importance to all mankind, and in the most unfavorable case we shall lose a few thousand dollars. The horizontal intensity, declination, and inclination of the earth's magnetism are measured daily with great precision in many places. Why is not the same interest shown in the more important electrical state of the earth? This should also be a matter for governmental investigation.—Translated for the SCIENTIFIC AMERICAN from Umschau.

The Harmful Effects of Ultra-Violet Rays on the Human Eye.

The action of ultra-violet rays on the human eye has been much discussed ever since Doctors F. Schanz and K. Stockhausen at the Congress of German Naturalists held at Dresden drew attention to the matter. Another interesting contribution toward a definite solution of the question was given by the same men in a lecture delivered before the sixteenth annual meeting of the Association of German Electricians, at Erfurt.

Many experimenters have investigated the influence of ultra-violet rays on the human organism, and their work has resulted in the therapeutical use of the rays, some affections of the skin being cured by an artificial inflammation due to their action. Ultra-violet rays of short wave length were found to act very intensely on the surface, whereas those of greater wave length penetrated to some depth. The action of the rays on the eye has likewise formed the subject of research.

Investigations carried out by Schanz and Stockhausen show that *ophthalmia electrica* is due to ultra-violet rays. The same disease, though in a less characteristic form, is produced also by many other illuminants containing a large percentage of ultra-violet rays. Snow blindness is similar in its symptoms to electrical ophthalmia and is likewise produced by ultra-violet rays contained in reflected sunlight.

That the action of ultra-violet rays, so far from being confined to the external eye, also affects its deeper parts, is evidenced by the intense fluorescence of the lens which they are able to produce. The lens thus converts the short-wave invisible rays into visible rays, acting, as it were, as a safeguard to the retina. Persons whose lenses have been extirpated are accordingly subject to attacks of erythropsia ("red visions"), especially in the case of intense lighting effects. This trouble can be observed at high altitudes even in normal eyes. As a slight turbidness is further produced in the lens by an intense lighting with ultra-violet rays, it may be said that the cataract of old age is possibly due to a progressive alteration of the lens.

Though an increase in the percentage of ultra-violet rays with increasing temperatures of the illuminant could be anticipated, Schanz and Stockhausen examined the usual lamps by means of a quartz spectrograph, the results of which are as follows:

The spectrum of crude oil lamps and candles hardly exceeds the region of visible rays. The ultra-violet range, however, extends as soon as a chimney is added. The same result is observed if the temperature of the flame be raised by means of an air blast, and an even more extensive spectrum is produced by using an incandescent mantle; but the longest ultra-violet spectra are found in electric illuminants, of which the mercury vapor lamp with quartz globe and arc lamps are found to come foremost. Nernst lamps likewise radiate a considerable percentage of ultra-violet rays. In all electric lamps fitted with a glass cover of any kind, the short wave lengths are absorbed by the glass.

The authors draw attention to the fact that blue protective spectacles afford no protection against ultra-violet rays, and that smoke-gray spectacles weaken the whole spectrum, for which reason they are not suitable for practical purposes. Because of the special importance of the question, they have undertaken the production of a new kind of protective glass which is now brought on the market under the name of "euphos" glass. This glass, which is of a light greenish-yellow hue, owes its remarkable power of absorbing ultra-violet rays to its special composition rather than to its color. The composition can be adapted to each kind of lamp.

With a very slight loss of light (3 to 5 per cent) this glass screens off entirely any ultra-violet rays. Special experiments made on animals show that it really affords an efficient protection to the eye.

Prizes for Essays on Street Cars.

To the senior students of the technical schools of the United States who will be graduated in 1909, the J. G. Brill Company, of Philadelphia, manufacturers of cars and trucks, offer $500 for theses on the subject, "Design of an Electric Railway Car for City Service." The authors of the three theses which in the estimation of a jury shall be considered most meritorious of those submitted, shall receive respectively in order of merit of their work prizes of $250, $150, and $100. The subject may be considered from any standpoint the student may elect or from all, i. e., from the standpoint of the construction of the car body, the standpoint of the truck, the standpoint of the electrical equipment and its arrangement, etc. Each thesis will be judged: 1. On its technical merit; 2, on the manner in which the subject is presented. A jury of three whose decision shall determine the winners of the respective prizes will be appointed to consider the relative merits of the theses submitted. The jury will include an electric railway official of prominence who is thoroughly conversant with the features and requirements of electric railway car construction; a member of the editorial staff of one of the technical journals in the electric railway field; and an expert in car construction.

The Current Supplement.

An interesting and novel application of concrete has recently been carried out in the erection of a new lighthouse in the Straits of Malacca. This the English correspondent of the SCIENTIFIC AMERICAN describes at length in the current issue of the SUPPLEMENT, No. 1712. James Hatch's paper on the development of the electric railway, in which he traces its marvelous growth, is concluded. The Action of Radium Emanation on Copper Salts is the title of an article in which Mme. Curie describes her experiments, and in which she fails to confirm Ramsay and Cameron's announcement of the degradation of copper to lithium by means of radium emanation. Francis Hyndman contributes an article on the absolute zero of temperature, which has been inspired by Prof. Onnes's recent achievement in liquefying helium. The British battleship "St. Vincent," the eighth of the "Dreadnought" type to be built for the British navy, is described and illustrated. The faked and the forged antique are made the subject of an amusing article by Mr. Tighe Hopkins.

The United States Forest Service will reforest about 3,000 acres of cut-over long leaf pine lands in South Florida, about twenty-five miles southwest of Ocala. After a careful study of the soil and forest-growing conditions here, the service has decided that the most practical method of doing this will be the planting of pine seed on the areas to be covered with trees, for starting the trees in a nursery and transplanting the seedlings in the field is not considered feasible because of the long tap roots produced by this species of pine, these roots rendering transplanting difficult. The experimental planting of the mesquite and several species of eucalyptus on these lands has been suggested also in this reforestation work. These will be the most extensive operations yet undertaken in the South.

Correspondence.

An Arrangement of Twin Propellers for Aeroplanes.

To the Editor of the SCIENTIFIC AMERICAN:

The lesson to be learned from the Wright disaster at Fort Myer, Va., is the fact that having two propellers on a horizontal line is radically wrong, as the forward thrust is shifted entirely to one side, if anything happens to either propeller, and no movement of the steering devices can overcome this side thrust, as the plane of resistance of the supporting surfaces is at nearly right angles to this side thrust. I designed an aeroplane some years ago and placed the propellers above each other to avoid this very contingency. The propellers being in a vertical line allows of a stronger and simpler plan, as one of them can be placed directly on the engine shaft, the other being either above but preferably below the line of the planes. Now if anything should stop one of these propellers, a change in the vertical steering rudder added to the higher speed of the remaining propeller would tend to overcome the loss of one, and would prevent the machine's falling, though it might sail slowly to the earth. Builders of aeroplanes will eventually be forced to adopt this arrangement of propellers, as it may be seen that it has other advantages than those mentioned above.

E. L. BAILEY.

Raleigh, N. C., September 26, 1908.

A Question of Priority of Invention.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the article entitled "Nasmyth—the Centenary of a Great Inventor," appearing in your impression of October 10, page 238, and partly quoted from the Engineer of London, allow me to correct two misleading statements as to Nasmyth's priority of invention. The article states that in 1838 Nasmyth brought out a self-adjusting bearing for the shafting of machinery, which consisted in giving a spherical form to the exterior of the bearing; also, he invented an inverted vertical steam engine. In Nasmyth's autobiography, edited by Smiles, the date of the latter invention is given as 1848.

It is far from my wish to detract in the smallest degree from the fame of Nasmyth. He was unquestionably a great inventor, but, as in the case of other great men, some of the prior achievements of his contemporaries were subsequently ascribed to him.

When Nasmyth was established at the Bridgewater Foundry, near Manchester, John George Bodmer, M.I.C.E., was in business at the Britannia Foundry in the same city. The two engineers were much in contact, and Nasmyth frequently consulted Bodmer on difficult matters of construction.

It must be explained that Bodmer was a native of Switzerland (born in 1786) and emigrated to England in the early thirties—partly for the reason that his native country gave no protection to inventors. At that time there was great opposition to foreigners, and the English engineers, as well as the workmen, threw every obstacle in Bodmer's way.

Nevertheless, he made a determined fight for success, and originated many improvements in machinery, among them being a spherical journal box in 1834 of the same construction as Nasmyth's of four years later. These spherical bearings were successfully used on locomotives and cars on English railways. In 1841 he invented the inverted vertical steam engine, anticipating Nasmyth by seven years.

Bodmer's diaries are now in my possession, and they give a highly interesting account of how this indomitable Swiss engineer, who was about fifty years in advance of his time, grappled with difficulties and obstructions which to-day are unknown to the scientific inventor.

During his residence in Switzerland and Germany in 1804, he invented spiral-gear wheels. In 1808 he made a breech-loading rifled cannon, which was thoroughly tested by the officers of artillery in the Grand Duke of Baden's regiment, and pronounced successful; but it was not adopted, for the world was not then ready for breech-loading firearms.

In England, in 1833, he invented the double-piston balanced steam engine, and locomotives on this principle were used on the London and Brighton and South-Eastern railways. Bodmer said that they ran with absolute steadiness at all speeds. They anticipated the balanced locomotive by about fifty years. The original drawings of these locomotives are in my hands; they had cylindrical slide valves, variable expansion valves, superheaters, feed-water heaters, and four-wheeled trucks.

At Manchester Bodmer introduced new forms of cotton machinery and machine tools, some of the latter being subsequently ascribed to Whitworth. Bodmer claimed to have improved the whole system of cotton spinning, one of his inventions being a carding engine, the drums or cylinders of which were self-stripping. He affirmed that if the English cotton-mill owners had adopted all of his improvements, they would have reduced the cost of production by one-half.

English engineers openly opposed him, but secretly copied his improvements, and in 1842 it was found that his inventions were in unlawful use in over sixty mills and machine shops in Lancashire; but Bodmer patented his inventions and proceeded against his infringers, from whom he collected heavy damages. He obtained fifteen patents in England and many more in foreign countries. Three of his English patents were so valuable that they were prolonged, at great trouble and expense, by special act of Parliament.

In 1842 Bodmer invented a rolling mill for rolling railway wheel tires in the circle, and these mills have been manufactured from that day to this, the latest being installed in the Standard Steel Works Company's shops; also a complete plant for the Japanese government.

In 1843 Bodmer brought out his patent air pump for condensing engines. The plunger of this pump was conical, and wiped over the ports in such a way that no valves were required. This valveless air pump is now, with slight improvements, being manufactured by a London syndicate.

Bodmer subsequently moved to London, and associated with the leading engineers of the day, including Brunel and Robert Stephenson; but they regarded him as a radical, and received him coldly. When he suggested that railway cars should be built with a central passageway and a lavatory for the convenience of passengers, he was laughed at. In 1846, at a meeting of the Institution of Civil Engineers, he was amused at the pompous way in which fuel consumption, tractive effort, and counterbalancing of locomotives were discussed by the great English engineers, without proper data. Bodmer affirmed that they were talking wildly, and the only way would be to build a stationary testing plant, so that the locomotive and its movements could be studied while the working parts were running at full speed. This was regarded as such an outlandish scheme, that it was not even discussed.

He tried to get his balanced marine engines built by Penn and Rennie, the leading marine engineers of London, but they feared him as a competitor, and told him that they would not build his engines, not even if they got orders from the British government.

In 1847 failing health necessitated Bodmer's return to Switzerland, where he designed machine tools for his son-in-law, Frederick Reishauer, who was a tool maker at Zürich. These tools were successful, and enabled Reishauer to start the extensive works at Zürich now known as the Actiengesellschaft für Fabrikation Reishauer'scher Werkzeuge, where some of Bodmer's machine-tool inventions are in present use, and where his drawings were lately discovered.

Bodmer died in 1864. He was one of the most brilliant inventors of the nineteenth century, but it is only now that engineers have begun to recognize the great scope and value of his inventions, and the part he played in the development of modern machinery.

HERBERT T. WALKER.

Binghamton, N. Y., October 12, 1908.

Rearmament of Warships.

To the Editor of the SCIENTIFIC AMERICAN:

You have recently published a couple of letters on the rearmament of our more important battleships and cruisers. The projects mentioned would, however, entail considerable reconstruction of ships and turrets, and, as you noted, the money needed to effect this could be spent to greater advantage on new ships.

It seems to me that by using more powerful 8-inch guns the required result might be easily obtained. A 50-caliber 8-inch gun, as used by the Russians, ought to be able to fire a 340- to 350-pound shell. (The new French 50-caliber 12-inch gun uses a shell correspondingly heavier than that employed in their 45-caliber model.)

An 8-inch gun thus equipped would have practically the same size shell and as great a velocity as the 50-caliber British 9.2-inch, which is considered equal to a 45-caliber 10-inch gun.

The increase in length and weight over the present 8-inch model would be very slight and, if the military masts, cranes, and flying bridges were removed from our battleships and cruisers, these guns might also replace some of the 7-inch and 6-inch, thus giving a broadside superior to the "Aki" or "Lord Nelson" for the battleships and to the "Kurama" or "Shannon" for the cruisers. Fifty-caliber guns are more easily worn out than 45-caliber ones, but still the 50-caliber are used.

T. B. THOMPSON.

Greenwich, Conn., September 11, 1908.

On October 11 Mr. Wilbur Wright increased his aeroplane record with a passenger to 1 hour, 9 minutes, and 45 seconds. His passenger in this flight was M. Painleve, a member of the French Institute. The flight was executed with perfect steadiness, and was the most successful that has as yet been made. After teaching three different men how to operate the aeroplane, Mr. Wright, according to report, will return to the United States.

V.—THE JAPANESE NAVY OF TO-DAY.

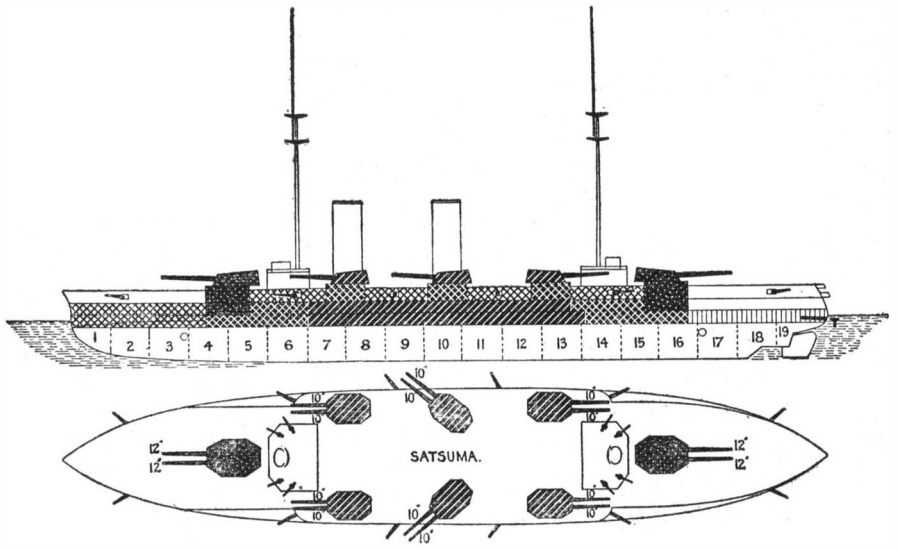
The fact that our Atlantic fleet of sixteen battleships is just now in a Japanese harbor and the recipient of Japanese hospitality gives particular interest to the present article on the Japanese navy. Comparisons of a friendly character will be inevitable, and it is a matter for considerable satisfaction to know that, in spite of the recent rapid growth of the Japanese navy, it cannot assemble, even to-day, so formidable an array of first-class battleships as that under command of Admiral Sperry.

The Japanese navy ranks fifth in importance among the leading navies of the world. The relative rank of the four other navies is Great Britain, United States, Germany, and France. Each of these has been treated in a separate illustrated article of the present series—the British navy on March 7, 1908, the United States navy December 7, 1907, the German navy August 8, 1908, and the French navy September 19, 1908. The rise of the Japanese navy to its present position as one of the leading navies of the world, has been rapid and highly spectacular. For the beginnings of her *modern* navy, we need go back not more than twenty years, or, say, to the commencement of the last decade of the nineteenth century. At that time her fighting strength consisted of three cruisers of the "Hashidate" class, each carrying a 12½-inch gun and eleven 4.7-inch quick-firers; the little armored cruiser "Chiyoda" of 2,450 tons; and a few smaller cruisers which to-day would be considered in the gunboat class. With this Lilliputian fleet she crushed the naval power of China and gave such evidence of latent genius for naval strategy and tactics that she won the instant respect of naval critics the world over, who predicted for her a brilliant naval future. The wresting from Japan of Port Arthur (one of the richest fruits of her victory) by the joint action of France, Germany, and Russia, stung deeply the pride and stimulated the activity of this valiant race. They immediately set about the construction of that fleet which, less than ten years later, in a series of brilliant victories, crushed the naval power of Russia and all but swept her navy out of existence. Although we have placed Japan in the fifth position in respect of the number, displacement, and fighting power of her ships, it should be remembered that the actual fighting value of a navy depends as much, if not more, upon its men as it does upon its material. Moreover, the fact that the Japan of the future will probably be fighting in her home waters, and within easy reach of her naval bases, will necessarily give her great advantage over any of the navies, more powerful on paper, with which she may have to contend. It is only during the last few years that Japan has undertaken the construction of ships in her own yards. Consequently, the bulk of her navy is of foreign build, and bears the impress of foreign design. The earliest ships of her modern navy were built in France; but the majority of her battleships and armored cruisers have been designed and constructed in English yards, notably those of Armstrong and of Vickers-Maxim. Consequently, her ships, and particularly the battleships, approximate more nearly those of Great Britain than they do to the ships of any other navy. Since the Russian war, however, Japan has progressed by leaps and bounds. She has struck out on original lines, and in her latest battleships and cruisers she has produced ships of large size, high speed, and carrying exceptionally heavy batteries. A particularly notable fact is the tenacity with which she has clung to the secondary battery. She followed the big-gun-ship fashion set by the "Dreadnought," without sacrificing the 6-inch gun; her latest battleships carrying a very formidable armament of 6-inch and 4.7-inch rapid-fire guns. Her new vessels are thoroughly up-to-date, and Japan has adopted the turbine as the exclusive motor power for her future vessels of large size.

SUMMARY.—The Japanese navy includes fifteen battleships of over 10,000 tons displacement, the oldest of which was launched in 1894, and most of which are not over ten years old. Their total displacement is 233,094 tons. Four of these, of the "Dreadnought" type, are at present under construction. The thoroughly modern character of Japan's navy is shown by the fact that it includes but one battleship of such early date as to relegate it to coast defense, and this is the "Iki," one of the Russian battleships captured at the battle of Tsushima. This vessel is of 9,672 tons. Japan is strong in armored cruisers, having thirteen of these ships with a total displacement of 136,212 tons.

Of second-class cruisers Japan possesses four, of 23,306 tons aggregate displacement. These are fast protected vessels with a speed of from 20 to 22 knots. There are also fifteen third-class cruisers of from 2,450 to 4,277 tons displacement—a miscellaneous lot of vessels ranging from the 25-knot "Sutsuya," formerly the Russian "Novik," to the 17-knot "Hashidate," of 4,277 tons, carrying as its main armament a 12½-inch gun. The total displacement of ships in this class is 52,025 tons.

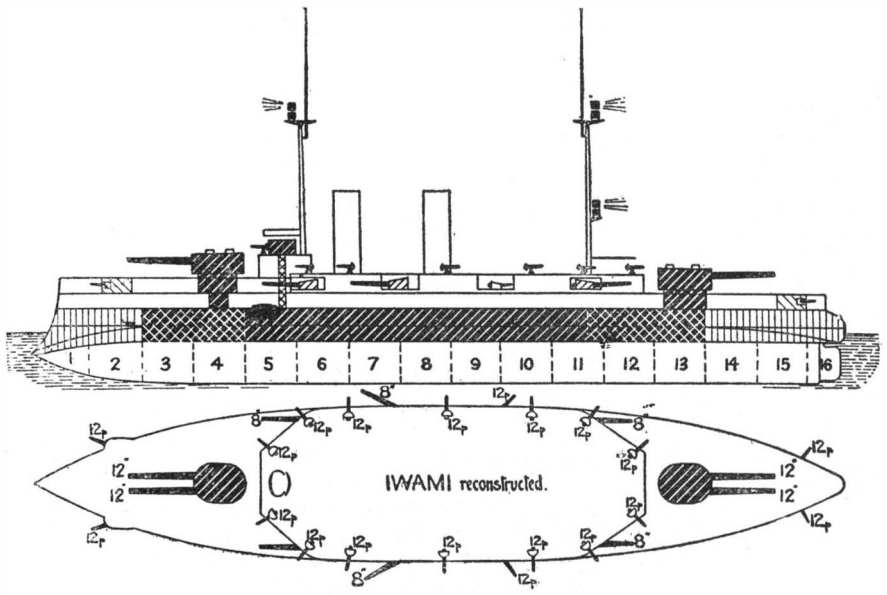
In the above enumeration we have considered only vessels which count for much in modern naval warfare. The Japanese navy includes, as do the other first-class navies, a considerable number of gunboats, old cruisers, and one or two obsolete battleships whose low speed, weak armament, or other defects place them outside of the list of effective ships. The fleet of Japanese destroyers is thoroughly modern, and includes sixty-four vessels built or under construction, ranging in displacement from 320 to 1,100 tons and in speed from 27 to 35 knots. The average displacement of these vessels, excluding a few of the latest designs, is about 350 tons, and the speed about 30 knots. The torpedo fleet also includes ninety-five torpedo boats, which will average in displacement about 125 tons with a speed of 28 knots. Of the ninety-five boats, forty-five are under construction. These are to have a speed of 27 knots and will displace 150 tons.



Displacement, 19,750 tons. **Speed,** 20.5 knots. **Coal,** 2,700 tons. **Armor:** Belt, 9 inches; deck, 3 inches; sides, 8 inches; turrets, 8 inches; central battery, 6 inches. **Guns:** Four 45-caliber 12-inch; twelve 45-caliber 10-inch; twelve 6-inch. **Torpedo tubes,** 5. **Complement,** 850.

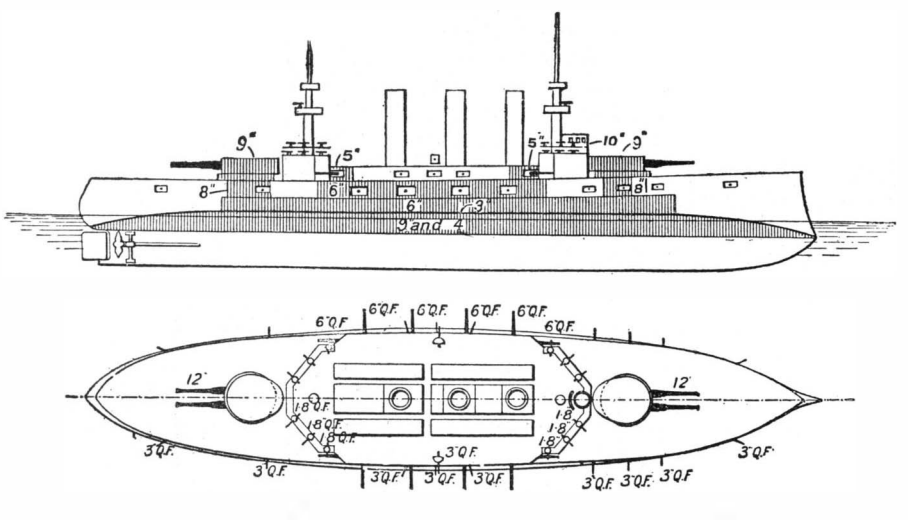
Battleships "Aki" and "Satsuma." "Dreadnought" type.

BATTLESHIPS.—The fleet of Japanese battleships is rather a heterogeneous collection of vessels, much more so than one would have expected from so methodical and judicious a people as this Oriental race have proved themselves to be. That the ships do not arrange themselves readily in classes, is due entirely to the rearrangement of naval forces and strength which took place in the Far East as the result of the Russo-Japanese war, in the course of which Japan not only lost two of her battleships, but also captured so many more than she had lost from Russia, that she actually emerged from the strife with a fleet much more powerful than that with which she entered. All of the captured battleships had suffered more or less severely from the gun, mine, or torpedo. Many of them had been sunk by the Russians themselves in Port Arthur on the eve of the surrender of that fortress. They were subsequently raised by salvage opera-



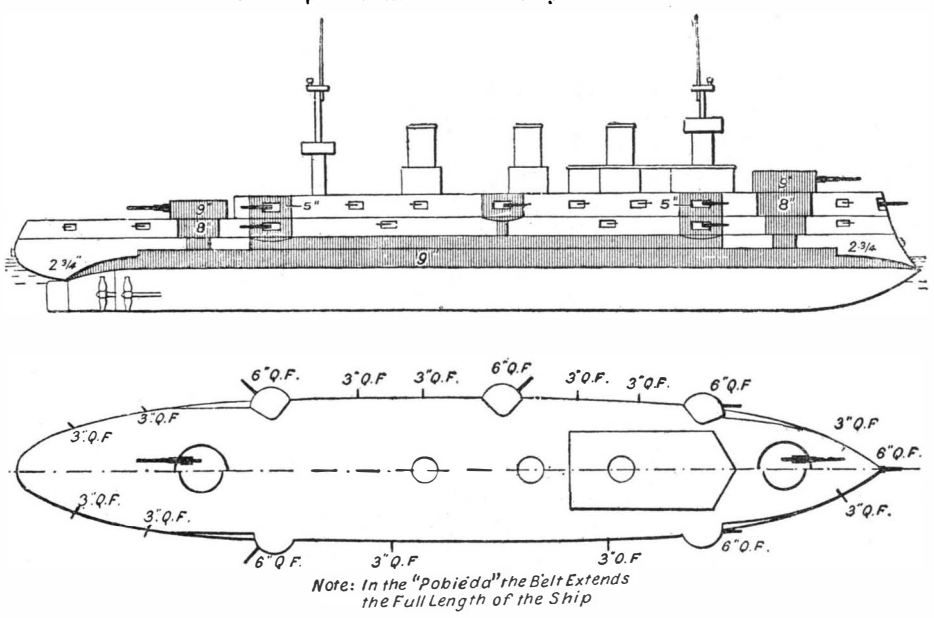
Displacement, 13,500 tons. **Speed,** 18 knots. **Coal,** 1,250 tons. **Armor:** Belt, 7¾ inches; deck, 3 inches; sides, 6 inches; turrets, 10 inches; shields, 6 inches. **Armament:** Four 12-inch 45-caliber Japanese guns; six 8-inch 45-caliber Japanese guns; twenty 3-inch. **Torpedo tubes,** 3. **Complement,** 750.

Battleship "Iwami." Formerly "Orel."



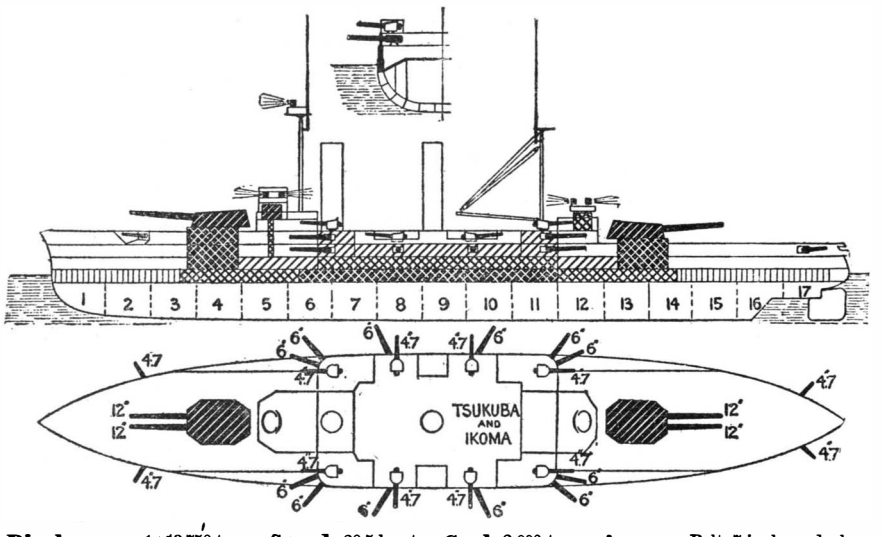
Displacement, 12,700 tons. **Speed,** 18.5 knots. **Coal,** 2,000 tons. **Armor:** Belt, 9 inches; deck, 3 inches; sides, 6 inches; battery and casemates, 5 inches; turrets, 10 inches. **Armament:** Four 12-inch; twelve 6-inch; twenty 3-inch. **Torpedo tubes,** 4. **Complement,** 750

Battleship "Hizen." Formerly "Retvizan."



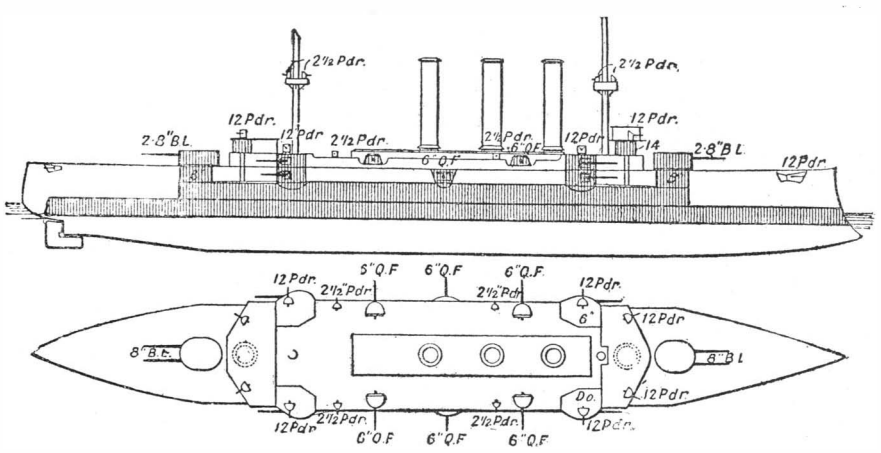
Displacement, 12,674 tons. **Speed,** 19 knots. **Coal,** 2,000 tons. **Armor:** Belt, 9 inches; deck, 2¾ inches; sides and casemates, 5 inches; turrets, 10 inches. **Armament:** Four 12-inch 40-caliber Japanese guns; ten 6-inch; twenty 3-inch. **Torpedo tubes,** 4. **Complement,** 730.

Battleships "Suwo" and "Sagami." Formerly "Pobieda" and "Peresviet."



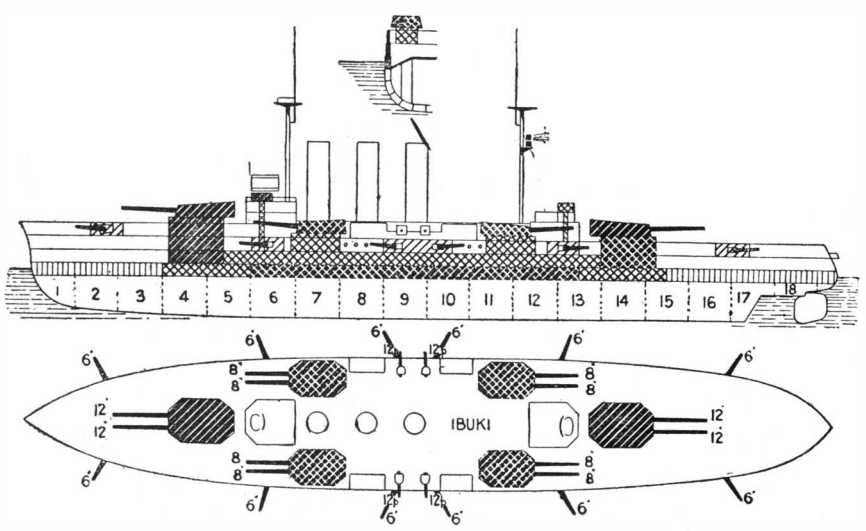
Displacement, 13,750 tons. **Speed,** 20.5 knots. **Coal,** 2,000 tons. **Armor:** Belt, 7 inches; deck, 2 inches; sides, 5 inches; turrets, 7 inches; battery, 5 inches. **Armament:** Four 12-inch 45 caliber; twelve 6-inch 45-caliber; twelve 4.7-inch: four 3-inch. **Torpedo tubes,** 5. **Complement,** 817.

Armored Cruisers "Tsukuba" and "Ikoma."



Displacement, 9,800 tons. **Speed,** 21 knots. **Coal,** 1,500 tons. **Armor:** Belt, 7 inches; deck, 2½ inches; sides, 5 inches; casemates, 6 inches; turrets, 6 inches. **Armament:** Four 8-inch; fourteen 6-inch; twelve 3-inch. **Torpedo tubes,** 4. **Complement,** 483.

Armored Cruiser "Idzumo." Six ships with slight variations.



Displacement, 14,600 tons. **Speed,** 22 knots. **Coal,** 2,000 tons. **Armor:** Belt, 7 inches; sides, 5 inches; deck, 2 inches; turrets, 7 inches. **Armament:** Four 12-inch; eight 8-inch; fourteen 4.7-inch; four 3-inch. **Torpedo tubes,** 5. **Complement,** 850.

Armored Cruisers "Kurama" and "Ibuki."

(Above diagrams from Jane's Fighting Ships and Brassey's Naval Annual.)

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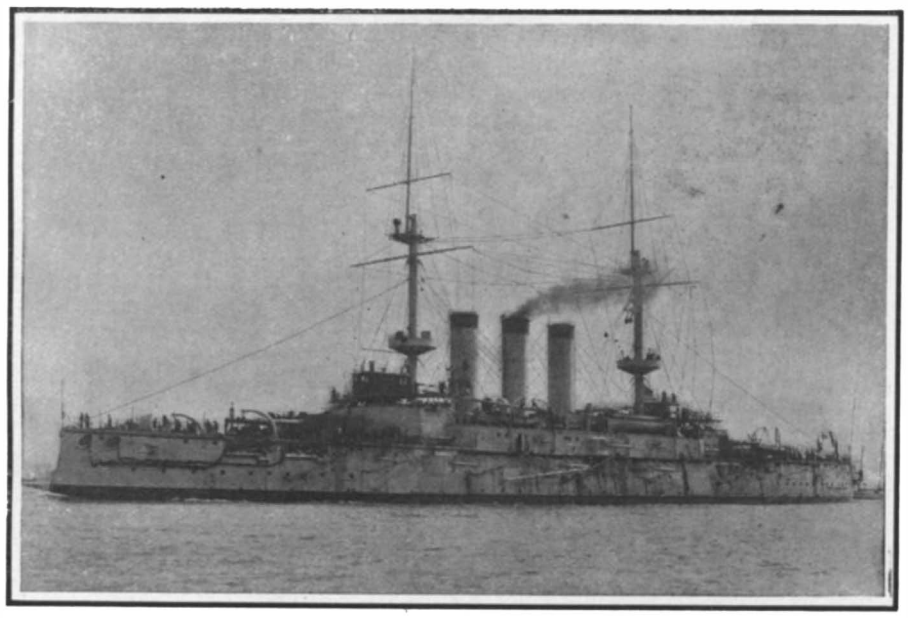
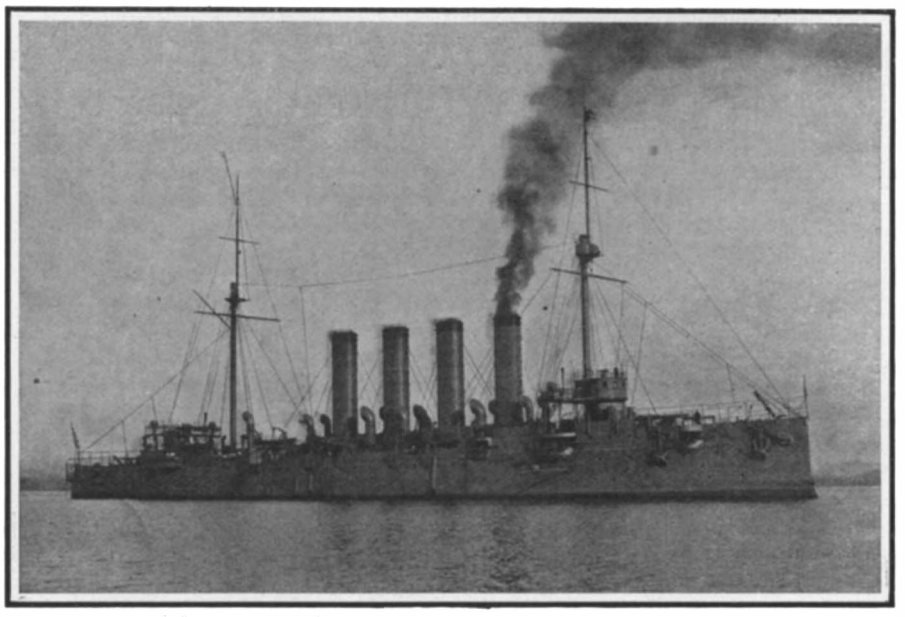
tions in which the Japanese betrayed remarkable patience and ingenuity; and they have been repaired and refitted and in some cases rearmed. The secrecy of the Japanese about their naval affairs renders it difficult to ascertain just what changes they have made. Generally speaking, the useless bridges and upper works have been removed or cut down; in some cases the batteries have been retained, in others replaced by more powerful Japanese guns. It is probable that these vessels are as effective and, in some cases, more so, than when they sailed under the Russian flag.

The most important battleships are four of the "Dreadnought" type, two of which are nearing completion, and the other two about one-third completed. The "Aki" and "Satsuma," built respectively at Kure and Yokosuka, are vessels of 19,750 tons and 19,500 tons displacement respectively. The "Aki" is designed to make 20½ knots with Curtis turbines of 25,000 horse-power. The "Satsuma" will be driven by reciprocating engines of less power and her estimated speed is about 20 knots. Outside of these differences in displacement, engine power and speed, the two vessels are practically identical. The Japanese evidently are not advocates of the high forecastle deck which has been adopted generally for battleships of the "Dreadnought" type. Their ships are flush throughout and have a freeboard of about 20 feet. The armor protection consists of a 9-inch belt thinned down to 6 inches at the bow and 4 inches at the stern. The protective deck is 3 inches in thickness. The armor belt is carried up to the level of the gun deck except from the after turret to the stern where it finishes at the protective deck. The 9-inch belt is carried up amidship to the gun deck, diminishing, however, from 9 to 8 inches, and the whole of the central battery is protected by 6 inches of armor. The battery is unusually powerful, including sixteen armor-piercing guns, four 12-inch and twelve 10-inch. The 12-inch, 45-caliber guns are mounted in two turrets, one forward and one aft, protected by 12 inches of armor. The 10-inch guns of 45 calibers are mounted in six two-gun turrets, three on each beam, protected by 8 inches of armor. For protection against torpedo attack the Japanese retained the 6-inch rapid-fire gun, eight of these being mounted on the gun deck within the central battery, and two on the same deck forward in sponsons and two in sponsons aft. The concentration of fire is two 12's, four 10's, and four 6's ahead and astern, and four 12's, six 10's, and six 6's on the broadside. It will be noted that the Japanese do not favor the mounting of the main battery on the center line as is done in our "North Dakota." The method adopted in the "Aki" and "Satsuma" involves the masking of one-half of the 10-inch battery at all times during an engagement. The two later "Dreadnoughts" laid down at Yokosuka and Kure in 1906 and 1907 are due to be completed in 1910, but little is known with certainty about these ships. They will be somewhat larger than the "Aki" and will displace between



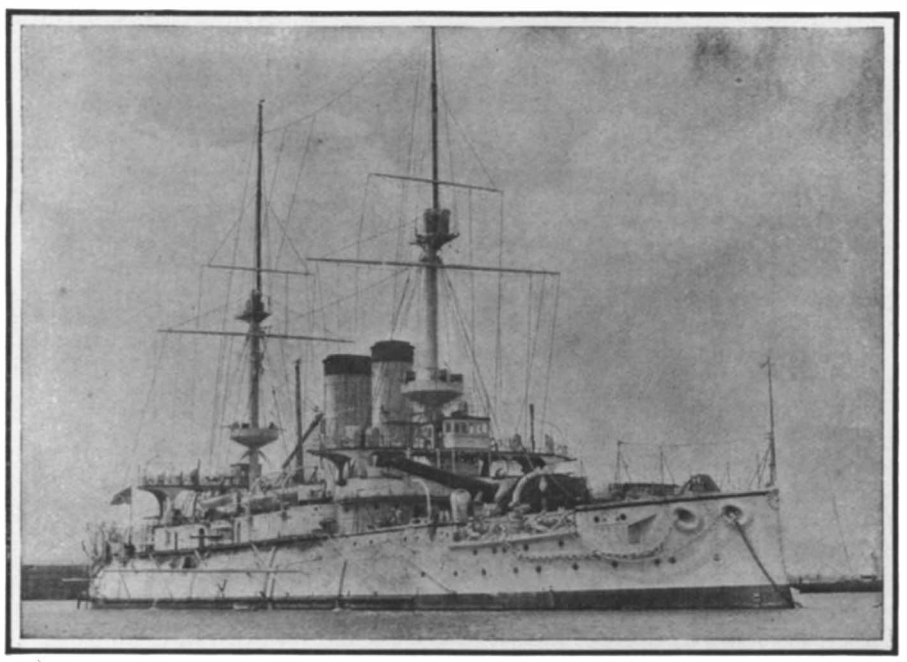
Displacement, 15,000 tons. **Speed,** 18.5 knots. **Coal,** 1,700 tons. **Armor:** Belt, 9-inch; deck, 3-inch; sides and casemates, 6-inch; turrets, 10-inch to 14-inch. **Armament:** Four 12-inch; fourteen 6-inch; twenty 3-inch. **Torpedo Tubes,** 5. **Complement,** 741.

Battleship "Shikishima."



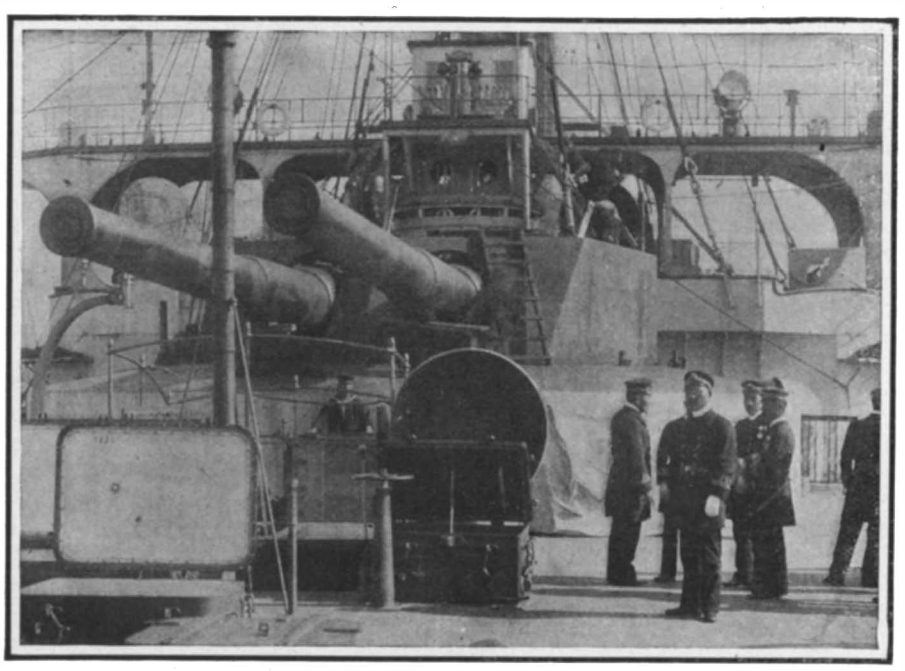
Displacement, 6,500 tons. **Speed,** 24.6 knots. **Coal,** 1,250 tons. **Armor:** Deck, 3-inch. **Armament:** Twelve 6-inch 45 caliber; twelve 3-inch. **Torpedo tubes,** 4. **Complement,** 571.

Protected Cruiser "Soya." Formerly "Variag."



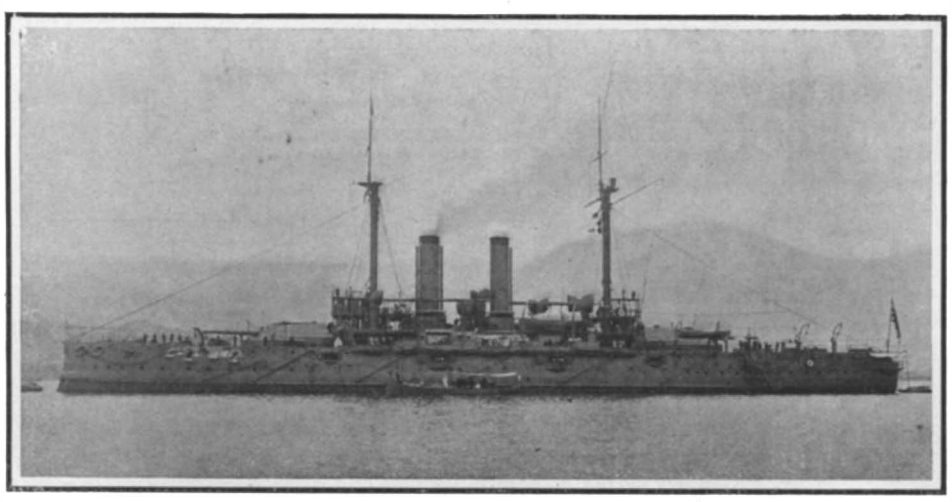
Displacement, 15,200 tons. **Speed,** 18.5 knots. **Coal,** 1,700 tons. **Armor:** Belt, 9-inch; deck, 3-inch; sides, 6-inch; turrets, 10-inch to 14-inch; casemates, 6-inch. **Armament:** Four 12-inch; fourteen 6-inch; twenty 3-inch. **Torpedo tubes,** 4. **Complement,** 770.

Battleship "Mikasa."



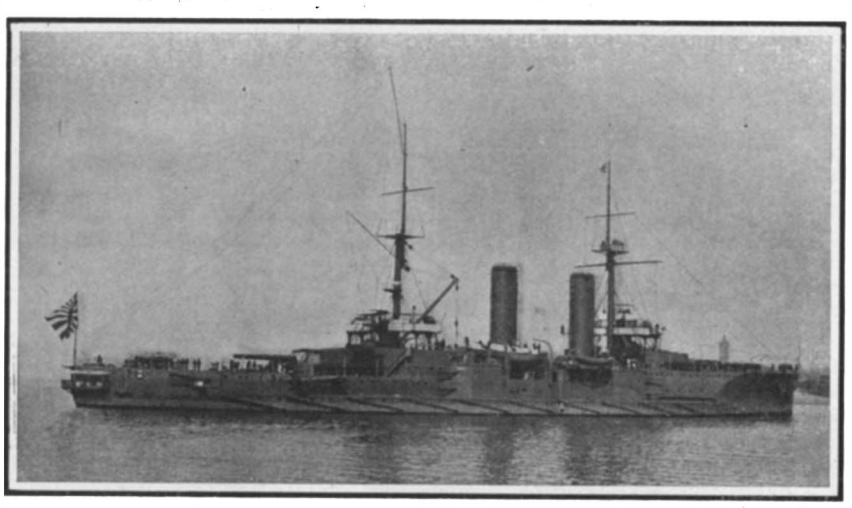
Weight of Shell, 850 pounds. **Velocity,** 2,400 foot-seconds. **Penetration of Krupp Steel** at 5,000 yards is 12 inches.

After Pair 12-inch 40-caliber Guns on the Battleship "Asahi."



Displacement, 12,300 tons. **Speed,** 18 knots. **Coal,** 1,500 tons. **Armor:** Belt, 18-inch; deck, 2½-inch; side, 4-inch; turrets, 1 -inch to 6-inch; casemates, 6-inch. **Armament:** Four 12-inch 40-caliber; ten 6-inch; sixteen 3-inch. **Torpedo tubes,** 5. **Complement,** 600.

Battleship "Fugi."



Displacement, 13,750 tons. **Speed,** 20.5 knots. **Coal,** 2,000 tons. **Armor:** Belt, 7-inch; deck, 2-inch; turrets, 7-inch; central battery, 5-inch; sides, 5-inch. **Armament:** Four 12-inch; twelve 6-inch; twelve 4.7-inch; four 3-inch. **Torpedo tubes,** 5. **Complement,** 817.

Armored Cruiser "Tsukuba."

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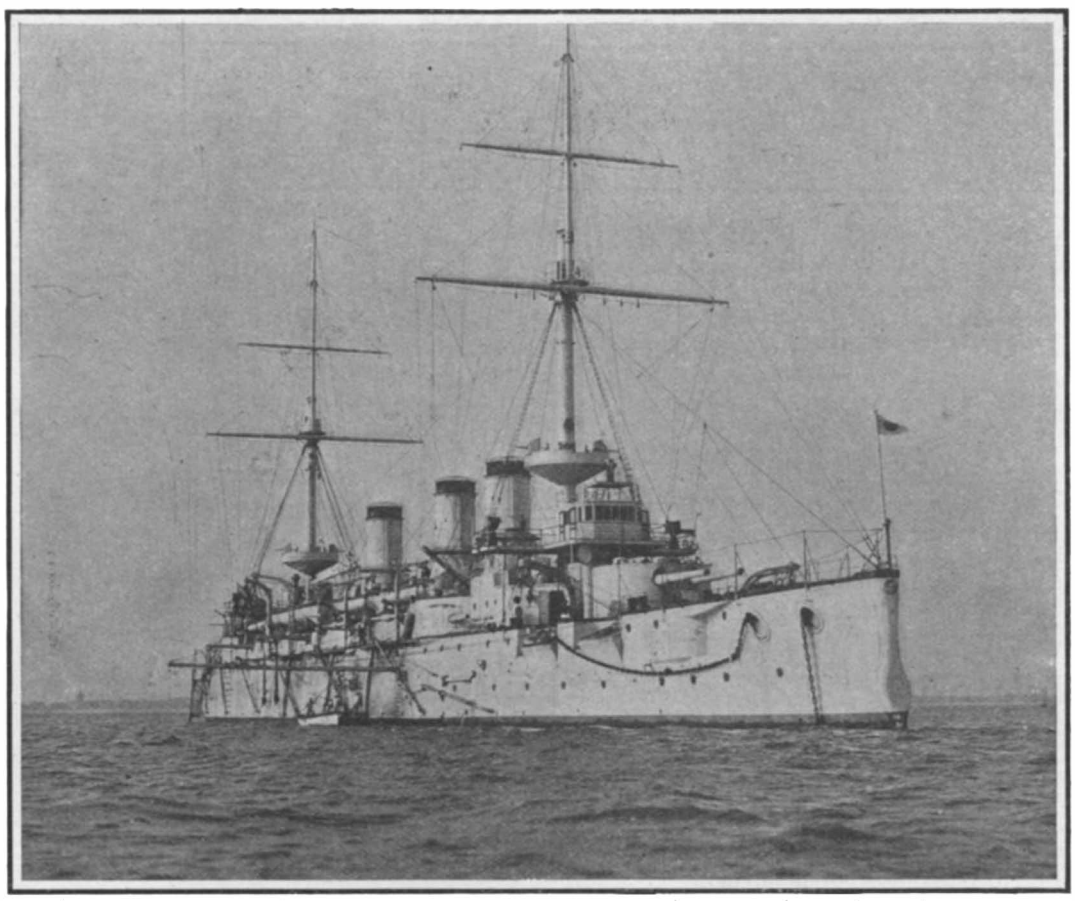
20,000 and 21,000 tons. They will be driven by turbines at a speed of about 20½ knots and will probably mount a dozen 12-inch 45-caliber guns, and a secondary battery of 6-inch and 4.7-inch guns. In view of the universal adoption by the other powers of the axial position for the 12-inch guns, it is probable that the batteries of these ships will be mounted on that plan, with two turrets forward, two aft, and one on each beam disposed diagonally so as to permit of the whole battery being fired on either broadside. The two most important battleships at present in commission are the "Kashima" and "Katori," built since the war in the Elswick and Vickers yards. They are halfway "Dreadnoughts," since they carry eight large armor-piercing guns, four 12-inch (in the customary positions, fore and aft), and four 10-inch mounted in single turrets, one at each corner of the central battery. The secondary armament consists of twelve 6-inch guns and a dozen 14-pounders. The 6-inch are mounted on the gun deck and the upper deck amidships. These vessels are of 16,400 tons displacement and on trial they made 19.2 and 20.2 knots respectively. The protection consists of a 9-inch belt thinning to 6½ inches at the end; a deck 3 inches on the slopes; 9 inches of protection for the main turrets; 8 inches for the 10-inch gun turrets; and 6 inches of side armor extending from the belt up to the main deck. With a coal supply of 2,000 tons, these vessels have a good radius of action; they are formidable ships, being somewhat more powerful than the "King Edward" class of the British navy. Next in importance are three generally similar battleships which went through the Japanese war, the "Mikasa," "Asahi," and "Shikishima." They are of 15,200 tons displacement and the speed is 18 to 18½ knots. The "Mikasa," famous as Admiral Togo's flagship, carries four 12-inch, fourteen 6-inch, and twenty 12-pounder guns. The same battery is mounted on the "Asahi" and "Shikishima," though the pieces are less powerful in the latter ships, being of 40 calibers as against 45 calibers in the "Mikasa." The armor plan also is similar in thickness and disposition. The belt is 9 inches thick, the deck 3 inches, and the protection to the barbettes and turrets is 14 inches and 10 inches. The "Asahi" and "Shikishima" have Harvey nickel armor. The "Mikasa's" armor was made under the Krupp process. A point of difference in the armor plan is that the secondary battery in the "Shikishima" and "Asahi" is mounted behind casemates of 6-inch armor, while the "Mikasa's" secondary battery is carried mainly behind a central armored redoubt of 5-inch armor. The bunker capacity of these ships varies from 1,400 to 1,700 tons. It will be remembered that the "Mikasa" was sunk during the war, and that she was subsequently raised and repaired. The "Fuji," of 12,300 tons and 18 knots, is the other surviving battleship of the war. She is now twelve years old, having been built on the Thames in 1896. She is similar to the ships of the "Majestic" class. She has a partial belt of 18-inch Harvey armor, with 4 inches of protection to the berth deck. Her ten 6-inch guns are carried in casemates, and her four 12-inch 40-caliber guns in two turrets, one forward and one aft. She is what is known as a soft-ended ship, there being no water-line protection forward and aft. The rest of the battleship fleet consists of vessels captured from Russia. The most important of these is the "Iwami," formerly the "Orel," which was captured at the battle of Tshushima, after being severely hammered by the Japanese, and was reconstructed in 1906 and 1907. As the "Orel," she was a high-freeboard vessel of the French type. The Japanese cut down the smokestacks, removed the bridges, lowered the gun positions and produced a serviceable and rather shapely vessel. The "Iwami" has a 7¾-inch belt, 10 inches of armor on the main turrets, and 6 to 4 inches of armor on the upper belt. She carries four 12-inch 45-caliber Japanese guns in two turrets and six 8-inch 45-caliber Japanese guns on the main deck, behind 6 inches of armor. Next in importance is the "Hizen," formerly the "Retvizan." She was built at Cramp's yard, Philadelphia; was torpedoed in the first attack on Port Arthur; went through the battle of August 10 off Port Arthur; was finally scuttled at the surrender; and was raised by the Japanese in 1905. Her battery consists of four 12's, twelve 6's, and twenty 12-pounders. She is protected by a 9-inch belt, with a secondary belt of 6-inch armor; has 10 inches on the turrets and 5 inches on the secondary battery and the casemates. Her speed on trial was 18 knots and she can stow a maximum amount of 2,000 tons of coal. She still carries her 40-caliber Russian guns; and, unless the Japanese have been able to effect very thorough repairs, her value must be considered to be doubtful. The other two battleships, "Suwo" and "Sagami," are practically twin ships and 12,674 tons displacement. They were formerly known as the "Pobieda" and "Peresviet." Both ships were sunk at Port Arthur and subsequently salved. They are characterized by a lofty spar deck, on which are mounted the forward guns of the main battery. Originally the main battery consisted of four 10-inch guns; but, in rearming these vessels, the Japanese have substituted four 12-inch 40-caliber guns. The secondary battery is mounted in casemates on the main and gun decks. The ships are protected by a 9-inch belt of Harvey armor, which is continuous in the "Suwo," but stops short of the ends in the "Sagami." The bunker capacity is good, being over 2,000 tons, and the designed speed is 19 knots. Among the second-class and coast defense battleships are the "Tango," of 11,000 tons, formerly the Russian battleship "Poltava," carrying four 12's and twelve 6-inch guns, built in 1894; the "Iki," formerly the Russian "Nikolai," carrying two 12's, four 9's, and seventeen 6-inch guns, all of obsolete pattern; and the "Okinoshima" and "Mishimi," captured at Tsushima, vessels of 4,200 tons displacement, armed, the former with three 10-inch, the latter with four 9-inch guns. The protection in each case consists of a 10-inch belt associated with a 3-inch deck.



Displacement, 9,456 tons. **Speed,** 21 knots. **Coal,** 1,300 tons. **Armor:** Belt, 7 inches; deck, 2⅛ inches; sides, 5 inches; casemates, 6 inches; turrets, 6 inches. **Torpedo tubes,** 5. **Complement,** 490.

Armored Cruiser "Adzuma."

V.—THE JAPANESE NAVY OF TO-DAY.

Armored Cruisers.—The most important armored cruisers in the Japanese navy are two 18,450-ton ships known as "X" and "Y," now being built in Japanese yards, which will be driven by Curtis turbines at 25 knots and will be armed with four 12-inch, eight 10-inch, and eight 6-inch guns. These vessels are to be completed in 1909. The "Kurama" and "Ibuki," of 14,620 tons, which are about completed, carry four 12-inch guns, in two turrets forward and aft; eight 8-inch in four turrets arranged at the four corners of the superstructure; and fourteen 4.7-inch guns, mounted behind casemates on the gun and main deck. These ships have a 7-inch belt, 2-inch deck, 7 inches on the main turrets, 6 inches on the secondary turrets. The "Tsukuba" and "Ikoma," of 13,750 tons and 20½ knots, have about the same armor plan as the "Kurama." They mount four 12-inch in two turrets; twelve 6-inch in a central redoubt of 5-inch armor and in casemates; and twelve 4.7-inch guns mounted behind shields. The "Kasuga" and "Nisshin," purchased from Argentina at the opening of the late war, are of 7,700 tons displacement and 20 knots speed. The armor plan shows a 6-inch belt, 5½ inches on the turrets, and 6 inches on the central battery. The "Kasuga" carries one 10-inch gun in a turret forward, two 8-inch in a turret aft, and fourteen 6-inch in the central battery. The armament of the "Nisshin" is similar, with the exception that the place of the 10-inch gun forward is taken by a pair of 8-inch guns. Next in importance is the fine armored cruiser "Aso," formerly the "Bayan," captured from Russia. She is of 7,800 tons and 21 knots; mounts two 8-inch and eight 6-inch guns and is protected by an 8-inch belt; a 3¼-inch upper belt, and 7 inches on the big-gun turrets. The rest of the armored cruiser fleet is made up of six excellent vessels, the "Idzumo," "Iwati," "Adzuma," "Yakumo," "Asama," and "Tokiwa." The "Adzuma" was built in France, the "Yakumo" in Germany, and the other four at the Elswick Works, England. The six vessels are so nearly alike that it is not necessary to describe them in detail. They are good for 20 to 21 knots and their displacement averages about 9,700 tons. They are armed with four 8-inch 40-caliber guns, carried in two turrets, and fourteen 6-inch guns mounted in casemates on the main and gun decks, with the exception of the "Yakumo" and "Adzuma," which have twelve such guns. The armor plan includes a 7-inch belt, a 2½-inch deck, 6 inches on the casemates and turrets, and 5 inches of side armor on the lower deck. They can stow from 1,300 to 1,400 tons of coal and they proved themselves, in the various actions of the late war, to be very serviceable ships.

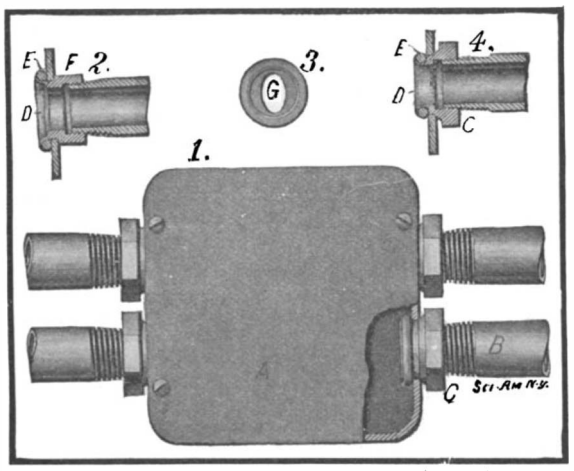
Protected Cruisers.—The progress of ideas in naval construction, strategy, and tactics, especially during and since the Japanese war, has relegated the protected cruiser to a comparatively insignificant position. The strength of the Japanese navy lies in its fine fleets of battleships and armored cruisers, and it is not necessary to say much, nor will space allow us, about the protected cruiser class of this navy. The latest of this type to be laid down are two vessels of 4,100 tons and 23 knots, carrying two 6-inch and twelve 4.7-inch guns, which are to be completed this year and next. At present they are known as the "Tone" and "B." These are Japanese-built ships, as are also the "Otowa," of 3,050 tons, carrying two 6-inch and six 4.7-inch guns, and the "Niitaka" and "Shushima," of 3,420 tons and 20 knots, carrying six 6-inch and ten 12-pounders. The "Sutsuya," formerly the "Novik," of 3,000 tons and 25 knots, mounting two 6's and four 4.7's, and the "Soya," formerly the "Variag," built at Cramp's, Philadelphia, are both captured Russian ships. The "Soya" is of 6,500 tons and is designed for 23 knots, though she made over 24. Her battery consists of twelve 6-inch and twelve 3-inch guns. Another Japanese protected cruiser that once flew the Russian flag is the "Tsugaru," formerly the "Pallada," sunk at Port Arthur in 1904, and salved in 1905. She is of 6,630 tons, and 20 knots speed. Her battery consists of eight 6-inch guns and twenty-two 3-inch. Two vessels of interest to Americans are the "Kasagi" and "Chitose," of 4,760 tons and 22½ knots speed. They were built respectively at Philadelphia and San Francisco, and both went through the war. The armament consists of two 8-inch and ten 4.7-inch guns. The "Asashi" and "Suma" are 20-knot vessels of 2,700 tons, designed and built in Japan. They mount two 6-inch, six 4.7-inch and twelve 3-pounders. The "Hashidate" and "Itsukushima," of 4,277 tons and 16½ knots, went through the Chinese war.

Torpedo and Submarine Fleet.—It is scarcely necessary to add anything to the summary of the destroyer and torpedo boat fleet that was given at the opening of this article, further than to say that of the five latest destroyers, four will be of 890 tons displacement and 33 knots speed, and one of 1,100 tons and 35 knots—this last being a smaller edition of the British 38-knot "Swift." The good service rendered by these craft during the war testifies to the quality of the fleet itself and of the personnel which manned them. The Japanese submarine fleet consists of nine vessels, with seven proposed or under construction. The most important of these are five Holland boats of 125 tons; two Japanese boats of 85 tons; and two built by Vickers of 320 tons. The Holland boats have a speed of 9 knots on the surface and 7 submerged; the Vickers boats can steam 8 knots submerged and 13 knots on the surface.

Patent Department

COMBINED NUT LOCK AND BUSHING FOR CONNECTION BOXES.

The invention which we illustrate herewith shows an improved method of connecting the ends of pipes to connection boxes, such as are used in electric wiring. The pipes are connected in such manner as to

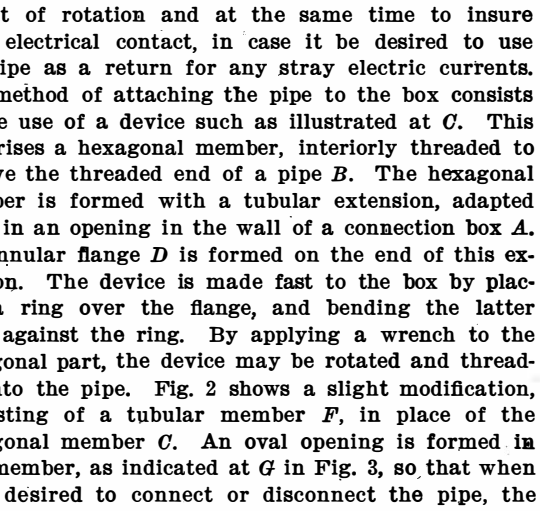


COMBINED NUT LOCK AND BUSHING FOR CONNECTION BOXES.

permit of rotation and at the same time to insure good electrical contact, in case it be desired to use the pipe as a return for any stray electric currents. The method of attaching the pipe to the box consists in the use of a device such as illustrated at *C*. This comprises a hexagonal member, interiorly threaded to receive the threaded end of a pipe *B*. The hexagonal member is formed with a tubular extension, adapted to fit in an opening in the wall of a connection box *A*. An annular flange *D* is formed on the end of this extension. The device is made fast to the box by placing a ring over the flange, and bending the latter back against the ring. By applying a wrench to the hexagonal part, the device may be rotated and threaded onto the pipe. Fig. 2 shows a slight modification, consisting of a tubular member *F*, in place of the hexagonal member *C*. An oval opening is formed in this member, as indicated at *G* in Fig. 3, so that when it is desired to connect or disconnect the pipe, the member *F* may be rotated by inserting a screw driver or any flat tool in the oval aperture. The rounded inner edge of the connection prevents wearing or cutting of the conductors which pass through the pipe. A patent on this device has been granted to Mr. J. S. Ritter and Dr. George F. Hummel, Ninth and Linden Streets, Allentown, Pa.

DOOR CHECK AND CLOSER.

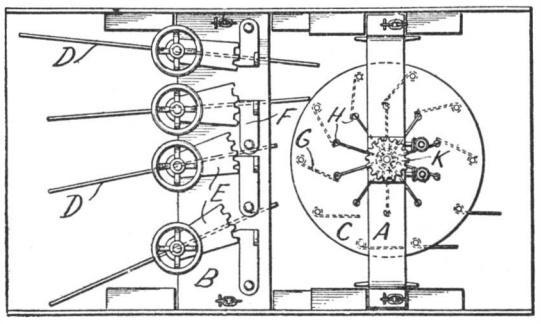
In the operation of automatic elevators, which are usually controlled by means of push buttons on the different floors, it is essential that the doors be closed after leaving the elevator, as otherwise the circuit is left open, and it is impossible for any one on another floor to bring the elevator to him. In order to insure the proper closing of the door, the mechanism illustrated in the accompanying engraving has been devised. The door of the elevator shaft is indicated at *A*, suspended from rollers *B*, which travel on an inclined track *C*. At one side is the closing mechanism, which is connected to the door *A* by means of a toggle lever *E*. In order to reduce the dimensions of this lever, one of the toggle members is made to telescope, as indicated at *F*, a spring serving to hold the member in its telescoped position. When the door is open, the toggle lever assumes the position illustrated by dotted lines. In swinging to this extended position, the two cranks *G*, which are fixed to the telescoping member of the lever, are swung on their axis, one of the cranks depressing a spring-pressed plunger in the cylinder *J*, and the other crank lifting a plunger in an oil cylinder *H*. The plunger in the latter cylinder is provided with a valve, which permits the oil in the cylinder *H* to flow freely through perforations in the plunger when the latter is lifted. On releasing the door *A*, the spring *K* serves to return the toggle lever to its normal position, drawing the door closed, while the oil in the cylinder *H* retards the plunger and cushions the movement to prevent concussion of the door when closing. This construction insures the closing of the door at all times, except when it is held open by the operator of the elevator. The mechanism is also applicable to any other type of elevator system, in which it is desired to insure positive closing of the doors without noise. The inventor of this elevator door closer is Mr. Joseph Fairhall, Jr., Danville, Ill.



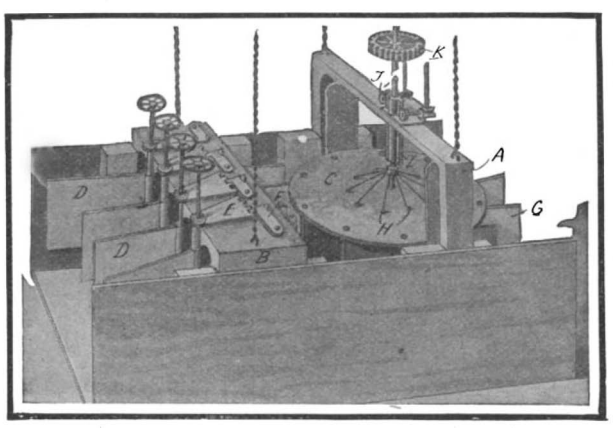
DOOR CHECK AND CLOSER.

WATER CURRENT MOTOR.

Pictured in the accompanying engraving is a water motor such as is used in streams and rivers for developing power. The motor is of the type provided with movable wings and it is furnished with means for controlling the position of the wings so as to enable the stopping or reversal of the wheel to be effected readily. The mechanism is carried in a flume which is lowered into the moving water. On the upstream side of the flume, the wings are mounted in



Plan view of the water-current motor.

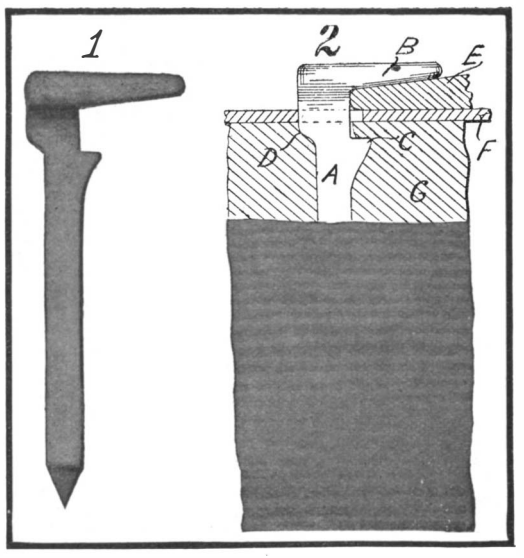


WATER CURRENT MOTOR.

position to direct the water against the vanes of the water wheel. The water wheel is supported in a frame *A*, which is suspended in such manner that it may be raised or lowered at will. Similarly, the wings are carried in a suspended frame *B*. The wings *D* are mounted on vertical shafts, provided with hand wheels at their upper ends. Secured to each shaft is a toothed sector *E*, the teeth of which are adapted to be engaged by dogs *F*. In this way they may be locked at any desired angle, so as to throw the water to one side or the other of the wheel *C*, depending upon the direction of rotation desired. The blades *G* of the wheel *C*, are pivoted at their outer ends, while their inner ends are free to swing against the stop pins *H*. The stop pins *H* are connected to a sleeve which is adapted to slide on the shaft of the motor wheel. This sleeve carries a rack *I*, engaged by pinions *J*, which may be operated by any suitable mechanism to lift the sleeve and raise the pins *H* out of engagement with the blades *G*. Thus, when it is desired to stop the wheel, it is merely necessary to raise the pins, permitting the vanes to swing free with the current. To reverse the wheel it is first stopped by withdrawing the pins, then the wings *D* are set to the proper angle, after which the pins are lowered once more and the wheel is turned by any suitable mechanism acting on the gear *K*, until the blades catch the current. The inventor of this improved water current motor is Mr. Asahel A. Porter, 329 North Willow Street, Waterbury, Conn.

IMPROVED RAILWAY SPIKE.

The railroad spike illustrated in the accompanying engraving is of such a design as to prevent it from working out of the cross-tie when in use. It is provided with an inclined shoulder which, when the spike is driven into the wood, forces it inward, or toward the rail. A second shoulder or projection on the inner side of the spike is thus made to bite into the wood, and securely hold the spike in place. In the illustration the head of the spike *A* is indicated at *B*. The head is flat and its lower face is inclined so that it will fit snugly over the lower flange of the rail. The inclined shoulder, referred to above, is indicated

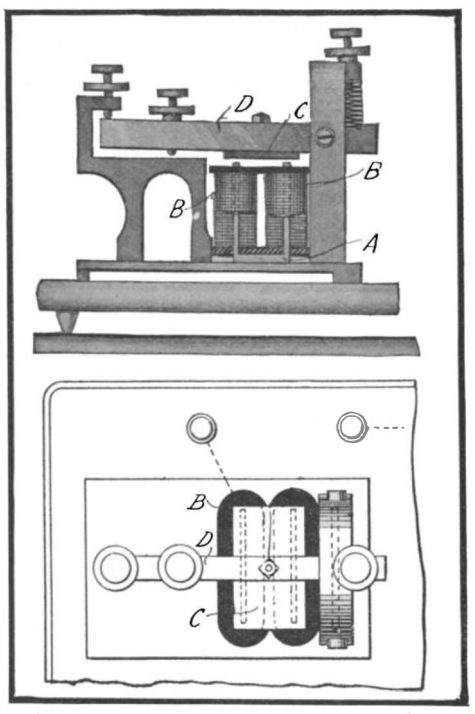


IMPROVED RAIL SPIKE.

at *D*, while on the opposite side is the projection *C*. The spike is designed to take advantage of the resilience of the wood of the tie *G*. It is started with its inner face about an eighth of an inch from the edge of the rail flange *E*. When the shoulder *C* engages the rail flange, the head of the spike springs back, permitting it to pass, and when the inclined shoulder *D* engages the tie plate *F*, the upper end of the spike is forced against the flange and the projection *C* is made to bite into the tie. If, in use, the spike works upward, the shoulder *C* will engage the under side of the rail flange, or the plate *F*, and thus be held in the tie. The result would be that while not giving perfect service in holding down the rail, the spike would at least keep the track from spreading. A patent on this railway spike is controlled by Mr. M. Sylvia, box 320, Goldfield, Nev.

AN IMPROVED TELEGRAPH SOUNDER.

A recent invention, which we illustrate herewith, provides an improved form of electro-magnet and armature, particularly adapted for use in telegraph sounders, to increase the sound produced by the apparatus. The sounder is mounted on a metal base supported only at the ends, so that it will act in the capacity of a sounding board. The core of the magnet consists of a flat plate bent to U-shape. Mounted on the two legs of this core are flat spools *B*, as indicated in the plan view. The armature lever *D* is provided with a broad armature plate *C*, adapted to be operated by the electro-magnets in the usual way. By using flat coils instead of the usual round coils, the poles of the magnet can be brought much closer together than usual, providing a much shorter path for the magnetic lines of force through the armature *C*.



AN IMPROVED TELEGRAPH SOUNDER.

In this way a louder sound is produced with the same battery, or if desired, the battery power can be cut down, for the sounder will make loud and sharp clicks with considerably reduced current. This type of magnet, while particularly designed for use in a sounder, should also be found useful in relays, electric bells, and various other forms of apparatus in which a mag

net is employed. The inventor of this magnet is Mr. Lee Kiblinger, of Jackson, La.

REPORT OF THE COMMISSIONER OF PATENTS.

The recently issued report of the Commissioner of Patents is a record of prosperity and industry that cannot but redound to the credit of the Patent Office. Summarizing the statistics which the Commissioner presents, we learn that there were received in the last fiscal year, ending June 30, 1908, 58,527 applications for mechanical patents, 1,091 applications for designs, 207 applications for reissues, 2,036 caveats, 7,467 applications for trade-marks, 810 applications for labels, and 339 applications for prints. There were 34,902 patents granted, including reissues and designs, and 6,135 trade-marks, 636 labels, and 279 prints were registered. The number of patents that expired was 24,270. The number of allowed applications which were by operation of law forfeited for non-payment of the final fees was 6,520. The total receipts of the office were $1,874,180.75; the total expenditures were $1,608,292.01, and the net surplus of receipts over expenditures, being the amount turned into the treasury, was $265,888.74.

The net surplus for the fiscal year ending June 30, 1907, was $275,103.19, and for the past fiscal year $265,888.74, so that the surplus is less by $9,214.45. The number of patents, trade-marks, labels, and prints patented and registered in the fiscal year 1907 was 44,121, and in 1908, 41,952, which shows a falling off of 2,169. The cost of printing same in the fiscal year 1907 was $271,178.48, and for the fiscal year ending June 30, 1908, $314,528.86

Although the number of patents issued was less by 2,169, the cost of printing the same was $43,354.38 more than in 1907. This is accounted for by the fact that the charges for printing made by the government printer were, during a portion of the past fiscal year, much greater than in previous years.

The falling off in the number of patents, trade-marks, labels, and prints registered and issued from 44,121 in 1907 to 41,952 in 1908 is accounted for by the fact that the number of registrations of trade-marks is gradually diminishing. In 1905, 10,408 trade-marks were registered under the new law; in 1907, 8,798, and in 1908, 6,135, which latter number will probably be about the normal number hereafter issued. The trade-marks registered are less this year by 2,663 than the previous year. Labels are less by 24 and prints by 46. There was an increase in the number of mechanical patents granted of 339. There were 66,795 applications for patents, trade-marks, labels, and prints filed in 1907 and 68,441 in 1908, an increase of 1,646 over the previous year. It will thus be seen that the volume of business from all sources is about the same as that during the fiscal year 1907.

Once more the Commissioner emphasizes the immediate necessities of the Patent Office. The volume of work is growing so uniformly from year to year, it calls for additional space. Further rooms must be provided for the examining and other divisions of the office. For the scientific library, which is much crowded, shelving space and additional steel stacks are required.

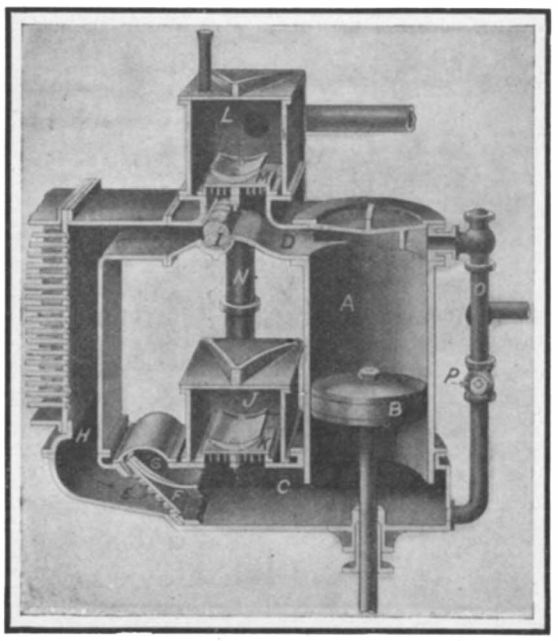
The net surplus of all years of receipts over expenditures which have been covered into the Treasury up to June 30, 1908, shows a grand total of $6,972,070.38. Nearly this whole sum has been paid by the inventors of the country; and inasmuch as they have paid the total expenses for the maintenance of the Patent Office, it is but fair to say that they are entitled to have a suitable building provided in which their business can be transacted in a prompt and efficient manner. The cost of this building and ground could be entirely paid for out of this surplus.

The Commissioner's former recommendations for increase of force and salaries is reiterated. Congress granted in part only the similar requests made last year. The following recommendations are made:

The salary of the Commissioner of Patents should be raised from $5,000 to $6,000 per annum, an increase of $1,000; the salary of the assistant commissioner should be increased from $3,500 to $5,000, an increase of $1,500, and he should be known in the future as first assistant commissioner; and an additional assistant commissioner at a salary of $4,500 per annum should be provided. The business of the office has increased enormously since these offices were created and the time of the commissioner and assistant commissioner is now mainly occupied in hearing cases on appeal and other judicial duties.

The Commissioner also advises that the salaries of the board of examiners in chief, the next lower judicial tribunal of the office, be increased from $3,000 to $4,500 each, which would call for an additional appropriation for this board of three members of $4,500; that the salary of the examiner of interferences, a court of first instance in this bureau, be increased from $2,700 to $4,000, as his duties, like the others above mentioned, are judicial. It is also asked that the salaries of the two law examiners be increased from $2,750 to $3,000, which will be a total increase of $500; that a chief of classifications be created at a salary of $3,600. This work calls for a man who must have had both legal and technical training; also that the salary of the examiner of trade-marks and designs be increased from $2,700 to $3,600, an increase of $900. The Commissioner advises that the salary of the forty-two principal examiners in the office be increased from $2,700 to $3,000, and an increase of ten fourth assistant examiners at $1,500, an increase of $15,000.

The work of the office has been and still is very much in arrears, but with the additional force allowed by Congress and available July 1 it will be possible after the new examiners have had a few months' experience to bring the work practically up to date in all the examining divisions of the office, probably by December 31, 1908.



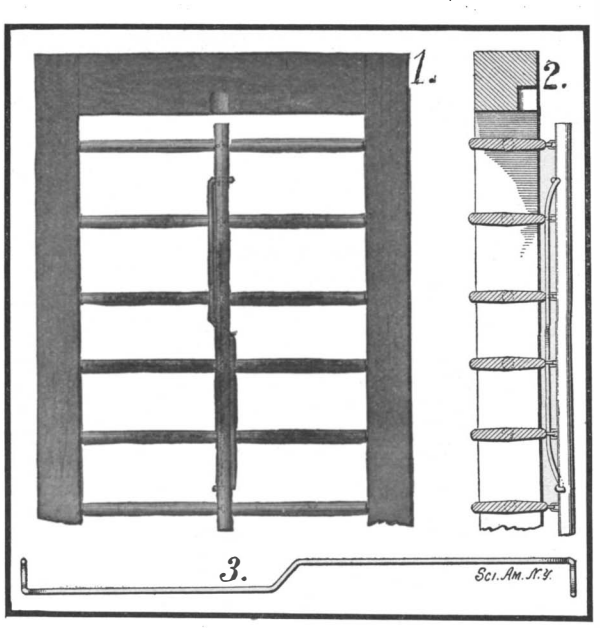
AN IMPROVED AIR PUMP.

The legislative, executive, and judicial appropriation act, which became effective July 1, embraces a provision in relation to the disposition of model records, which has been commented upon more than once in these columns. The act provides that those models which are of possible benefit to patentees or of historical value, shall be cared for in the New National Museum Building, the remainder to be disposed of by sale, gift, or otherwise.

Under this authority some of the models have been placed in the Smithsonian Institution; 4,000 unapplied models have been sold, and the balance, which were deemed necessary to retain as records for office and court use, are being boxed, labeled, and catalogued, and stored temporarily in the basement of the Department of the Interior building until the completion of the new building of the Smithsonian Institution, where the law directs they shall be finally deposited.

A NEW SHUTTER ATTACHMENT.

The accompanying engraving illustrates a simple device which may be applied to shutters, so as to hold the slats in open or closed position, or at any angle desired, and to prevent them from rattling. The device consists of a spring member, which is placed between the slats of the shutter and the slat rod, to frictionally engage the slats and rod and hold them securely at any position. The spring member referred to consists of a wire rod, which is bent at the center so as to form two offset sections, which lie at opposite sides of the slat rod and bear against the slats. The ends of the wires are bent to conform to the shape of the slat rod, so that they can be seated thereon. The two sections are bowed slightly, so that when placed between a rod and the slats, they will exert a pressure which will hold the members in set position. The spring rod can be applied very quickly to any shutter, and owing to its resilient engagement of the slat and rod, will prevent the shutter from rattling in a wind. Mr. John L. McCaleb, of Carrizo Springs, Texas, has recently received a patent on this simple shutter attachment.



A NEW SHUTTER ATTACHMENT.

AN IMPROVED AIR PUMP.

The air pump illustrated in the accompanying engraving is especially designed for use with steam condensing apparatus for all types of steam engines and vacuum pans, and is arranged to produce a very high vacuum. The pump is of the double acting type, one end exhausting the gas and air from the condenser while the other withdraws liquid from the lower portion of the condenser, and the construction is such that water is injected into the air end of the pump to insure the complete expulsion of the gases and air and seal the piston. The engraving illustrates the pump in section as applied to a surface condenser of the tube type. The pump cylinder is indicated at *A*, and operating therein is a piston *B*. The cylinder *A* communicates at its lower end with a passageway *C*, and at its upper end with a passageway *D*. At one end of the passageway *C* is a grated opening *E* over which a flexible flap valve *F* is fitted. A guard *G* is arranged above the flap to limit its outward movement. Through the opening *E* the passageway *C* communicates with a passageway *H* which in turn communicates with the tubes of the condenser. The passageway *H* also communicates with the passageway *D* by way of the semi-rotative valve *I*. Above the passageway *C* is a chamber *J* communicating therewith through a grated opening which is fitted with a flap valve *K*. Similarly, the passageway *D* communicates with a chamber *L* through a grated opening which is fitted with a flap valve *M*. In operation, when the piston *D* moves downward, the valve *I* is open and the gases and air from the condenser are drawn therethrough and into the passageway *D*. At the same time the water in the passageway *C* is forced past the valve *K* into the chamber *J* and thence is discharged by way of a pipe *N*. A portion of the water passes through the pipe *O* and into the upper end of the cylinder *A*. On the return stroke of the piston, the valve *I* is closed and the gases and air are forced into the chamber *L* and out of the discharge pipe. The valve *P* in the pipe *O* is arranged to permit sufficient flow of water into the upper end of the cylinder on the down stroke of the piston so that on the return stroke of the piston it will completely fill the passageway *D*, overflowing into the chamber *L*, thus forcing all of the gases and air out of the passageway *D* and water-sealing the valve *M* on the next down stroke of the piston. The inventor of this improved air pump is Mr. Charles A. Hague, of 52 Broadway, New York, N. Y.

Artificial India Rubber.

1. Heat together 6 pounds of gelatine and 6 pounds of glycerine, until they form a viscous mass. Then add 1 pint of linseed oil and continue to heat until the mixture becomes homogeneous. Next add 2½ ounces of formaldehyde or, preferably, of trioxymethylene in powder, previously well mixed with half as much manganese dioxide. Heat until all is dissolved, then pour into molds and allow to cool.

2. The process is the same as above, except that the oil is mixed with 1/10 its weight of sulphur before it is added to the mixture, and that the manganese dioxide may be omitted. The casting, after it has cooled and hardened, is removed from the mold and heated to 300 deg. F. for an hour, in order to enable the sulphur to act thoroughly on the oil. In this way articles of imitation vulcanized rubber can be made.

3. This process differs from the last by the incorporation of 8 per cent of tar, in addition to the 10 per cent of sulphur, with the oil. The toughness of the product may be increased, without affecting its compressibility, by mixing with the mass, while it is still in a viscous state, short fibers of wool, cotton, etc. It is then vulcanized as in process No. 2.

A novel mode of warfare against the mosquito, but one that is proving highly successful, is being carried on in the city of Tampa, Fla. There are many rain-water tanks and cisterns throughout the city for supplying water for lavatory and various other purposes, and these are favorite breeding places for mosquitoes. The warfare against the annoying pest consists in stocking these reservoirs with small fish to feed on the mosquito larvæ. This method has been tried in one place and another in Florida, and has proved successful in every case. The fish eat the larvæ greedily, keeping the water clear of them, and live for years, even in tanks that are covered, and their living place one of darkness.

RECENTLY PATENTED INVENTIONS.

The Inventions described in this Department were Patented through the Scientific American Patent Agency.

Electrical Devices.

ELECTROSONATOR.—R. SAKAMOTO, Tokyo, Japan. The device relates to sound transmitters for transmitting sound into the human body to an internal organ. The sound is produced by a vibrator operated from an electromagnet. In use the examiner who listens through a stethoscope applied to the body near the sound-producer may determine the exact position, form, and motion of the internal organ of the body, as well as accurately determine any dislocation, enlargement, or diseased condition.

Of Interest to Farmers.

PROCESS FOR EXTRACTING HONEY.—L. W. AVANT, Atascosa, Texas. By means of this invention the honey may be extracted from beehives without opening the hive or materially disturbing the bees, and without robbing the hive of the wax of which the cells are made. The advantage of this is that it relieves the bees of the labor of gathering the wax, thus economizing time and allowing the bees to devote their undivided energy to the gathering of honey.

Of General Interest.

WATERPROOF FUSE CAP.—T. M. DANIELS, Valdez, Alaska. This cap is adapted to be attached readily to the end of the fuse in a watertight manner. Its design is such as to prevent the occurrence of "miss-fires" or "miss-holes" in blasting, which are largely due to the fact that the explosive in the cartridge becomes wet.

MATTRESS.—F. A. KAISER, Scranton, Pa. As usually made it is difficult to fill the edge of a mattress uniformly throughout its length with the stuffing or filling material so that the "roll edge" is uniform. In the present invention a separate strip of felt, cotton batting, or the like, is provided, which is placed along the inner surface of the covering and through a portion of this strip, after the roll edge is formed complete, the main body of the stuffing or filling material may be inserted in the ordinary manner.

LOCK FOR BAG FRAMES.—L. B. PRAHAR, New York. The special object of this invention is to provide a lock in which the thumb piece of the latch is formed integral with the body of the latch, and extends through an opening in the side of the casing. The casing is so formed that the thumb piece may be readily removed to a position parallel to the bag frame, but further movement is prevented by engagement of the thumb piece with the casing.

MOTH BALL HOLDER.—G. THOMPSON, New York, N. Y. This moth ball holder is adapted to be attached to the frame of an upright piano in a position above the action, and without interfering therewith. The holder will retain the ball until all is evaporated, thus not only serving to protect the felt of the action from the moths, but to prevent particles of the moth ball from dropping into the case.

SPOOL CASE.—C. J. ALFRED, New York, N. Y. This case is adapted to be applied to a work basket and is so arranged as to permit the free withdrawal of the thread, but it will frictionally bind the same and prevent its unwinding except when intentionally pulled out. The device is provided with a cover which grips the thread and severs it at the points desired.

FAN.—E. GOOSCH, New York, N. Y. The fan is of the rotatable type for hand use. The leaf of the fan is mounted on a spindle which may be rotated by reciprocating a thumb piece which projects from one side of the fan handle. The object of the invention is to enable a person to fan himself with little exertion.

CIRCULAR BACK FOR CAMERAS.—E. L. HALL, New York, N. Y. The purpose of this invention is to provide a circular back adaptable to almost any type of camera by means of which a plate holder may quickly and readily be shifted from one position to another without removing it from the apparatus.

STEVEDORE RIG.—J. KNUPPEL, New York, N. Y. The object of this invention is to enable the cargo to be not only lifted out of the hold of the vessel, but swung sideways on to the dock by the mere action of hauling on the hoister line. This object is attained by a peculiarly rigged gaff along which the hoister line runs and by means of which the hoister acts first to lift the cargo out of the hold, and then to swing the gaff and its load sidewise over the dock.

Household Utilities.

CONNECTION FOR WATER RECEPTACLES.—E. F. COOK, Freeport, N. Y. This invention is particularly adapted to provide a connection suitable for laundry tubs which will furnish suitable valves independent of each other for directing hot or cold water or both, through a single outlet into the tub.

WINDOW LOCK.—C. C. HIGGINS, Woodmere, N. Y. The invention relates to window locks, providing a type of lock in which there are two bolts, one for each sash, but in which these bolts are independent of each other for some purposes, and yet work in unison for other purposes.

WINDOW-BLIND GUIDE AND STOP.—W. W. BRUCE, Baltimore, Md. In raising and lowering window shades that are wound on a spring-actuated roller, it often occurs that the shade slips out of the hand and flies up, wedging the stick in the bottom hem between the roller and the window frame so that it causes a good deal of trouble to release it. The present invention obviates these difficulties by providing guiding means and a stop for the shade.

Machines and Mechanical Devices.

MILK PURIFIER AND HOMOGENIZING MACHINE.—H. H. STÜSSY, Sioux City, Iowa. The invention relates to machines of the class in which milk is passed centrifugally through purifying and homogenizing media, and in which the impurities and the homogenized milk are separately discharged from the machine. In the present invention the milk is conducted through straining media and then through an irregularly-shaped conduit which causes the globules of butter fat to be broken up and disseminated throughout the milk.

CANNON PINION.—W. F. JOST, Pocatello, Idaho. The invention relates to horology and has for its object to provide a cannon pinion securely locked to the center arbor to prevent lifting and throwing it out of gear with the minute wheel, to provide true and even friction, to carry the hands safely when the watch is running, and not to interfere with the motion of the balance wheel when setting. The arrangement allows of placing or removing the cannon pinion to and from the arbor without springing the latter or breaking the jewels.

CONTROLLING MECHANISM.—H. MEYER, New York, N. Y. The invention is adapted for use on self-playing pianos. It provides a mechanism arranged to control independently the tempo, action, expression, the damper, and the hammer rail in a very simple and efficient manner.

BLACKING MACHINE.—E. E. TALIAFERRO, Colorado Springs, Colo. In this bootblacking machine a set of brushes are provided which travel around the foot form on which the shoe is placed, so as to efficiently polish all parts of the shoe. Means are provided for withdrawing the brushes to permit of placing the shoe in position. The mechanism automatically stops after completing the cycle of operations.

LATHE ATTACHMENT.—A. E. WHITING, Weston, W. Va. The invention relates to boring engine cylinders and the like and its object is to provide an improved lathe attachment designed for quickly and accurately centering the work to bring the latter in axial alinement with the lathe.

MACHINE FOR UNRAVELING TEXTILE FABRICS.—P. F. VOGEL, Clinton, Tenn. The object of this invention is to provide an inexpensive mechanism to be used in combination with loopers which join together edges of knit goods. It serves to unravel the selvage edges of such goods and to wind the unraveled yarn upon a reel.

UNIVERSAL INDICATOR.—H. P. BOETTCHER, Jersey City, N. J. This indicator is more especially designed for tool makers' and machinists' use, operating, when applied to the work, to accurately and automatically show to what extent, if any, the work is out of true.

UNIVERSAL ELEVATING AND LOWERING DEVICE.—E. G. GEBAUER, Santa Fe, New Mexico Ty. The construction provided by this invention operates to maintain a cable in a constant position as it coils or uncoils from a drum. The drum is arranged to travel to and fro as it rotates, the reversing of the travel being accomplished automatically.

Prime Movers and Their Accessories.

STEAM SERVICE CONTROLLING AND RECORDING APPARATUS.—G. M. HILGER, Chicago, Ill. This invention provides an apparatus intended for use in connection with steam service plants by means of which to automatically reduce steam pressure to the desired degree, and to record the differences in pressure and the volumes of steam delivered, whereby to admit of convenient computation of the horse-power and other conditions concerned with the steam service.

EXPLOSION ENGINE.—A. W. COTTRELL and M. A. MOORE, Douglas, Ariz. Ty. In this explosion engine there are three explosion chambers and four feed valves, causing twelve explosions at every revolution. The chambers being long permit the exploded gases to expand to atmospheric pressure before leaving the engine thus giving more power from a given amount of fuel, reducing the noise of the exhaust, and acting as a cooling agent to the engine.

Railways and Their Accessories.

SAFETY APPARATUS FOR RAILWAYS.—A. BONOM, New York, N. Y. By providing trip devices which are placed at intervals along the track, and controlling mechanism operable by these trips on trains going in either direction, Mr. Bonom furnishes a safety apparatus which operates effectively to prevent two trains from meeting when going in opposite directions on the same track. The mechanism also prevents rear-end collisions.

JOURNAL BOX.—W. A. HUFF, Newark, N. J. The object of this invention is to provide a journal box of simple construction having improved means for lubricating the wearing surfaces and for preventing a waste of oil from the box by working along the journal. The construction tends to keep the oil in a clean condition. Provision is made for the automatic deposit of solid particles which may accumulate in the oil.

Vehicles and Their Accessories.

PNEUMATIC TIRE.—H. W. DOVER, Holyrood, St. James, Northampton, England. The invention relates particularly to means for securing pneumatic tires in position and its principal object is to pr vide a construction which will so hold the tire that the effect of the internal pressure will be to cause the tire to become more securely fixed in position instead of tending to become detached by increase of its diameter as heretofore.

COMBINED VEHICLE JACK AND WRENCH.—D. C. LASSITER, Shelmerdine, N. C. The invention relates to that class of jacks which support a wheel when it is removed from the spindle, in order that lubricant may be placed on the spindle. The object of the present invention is to provide a simple and convenient device for facilitating the handling of the wheels of the vehicle while lubricating the spindles.

Designs.

CASING FOR SODA-WATER FOUNTAINS.—C. F. POWERS, Coosada Station, Alabama. This patent presents a casing for soda water fountains including a body portion surmounted by a number of jars in two series, the larger jars being arranged in rear of the others, and the smaller jars appearing in a row across the front of the casing and above the body portion, all of the jars being similar in appearance and having each an ornamental cover.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Full hints to correspondents were printed at the head of this column in the issue of August 8th, or will be sent by mail on request.

(10921) C. L. H. asks: Can you tell me if any one makes an electric arc that could be used as a blowpipe? I wish to use it to melt small amounts of platinum. A. It is not difficult to arrange an electric arc blowpipe for melting metals or soldering. We should use the current which passes through the carbons for the magnet. Put the magnet of a few turns of wire in series with the carbons. Adjust the number of turns of wire and the distance of the magnet from the arc to produce the blowing power required. The apparatus is so simple that no special instruction is required for setting it up or operating it.

(10922) F. B. W. asks: Can you explain the phenomenon of the Aurora Borealis? A. We cannot explain the theory of the Aurora Borealis. The most we can do is to state the view held by the best scholars concerning it. To begin with, highly heated metals or carbon send out numerous minute particles with high velocities. These particles are called corpuscles, or electrons. They are known to carry charges of negative electricity, and to move with a very high velocity. It is reasonable to regard the sun and other stars at their enormous temperatures as sources of such particles, which move in mighty streams through the celestial spaces. When such particles strike a rarefied gas they render it luminous, as is seen in vacuum tubes. Such luminosity is associated with the discharge from the negative electrode of these tubes and has a name —"cathode rays." In the upper air these corpuscles from the sun may well be considered to produce luminous effects, such as the auroral light. Arrhenius first suggested this theory of the aurora, but it is now quite generally adopted. Duncan's "New Knowledge," price $2, page 238, gives it in some detail. It is also to be found in Thomson's "Conduction of Electricity through Gases," price $4.

(10923) E. E. asks: How is the focus of a concave lens determined? Is it the radius of a circle, or half the radius of the curvature? Please inform me as to both plano and double concave. A. All foci of concave lenses are virtual. For a biconcave lens of glass, whose index of refraction is 1.5, with the same radius of curvature on each face, the principal focal length is equal to the radius of curvature. For a plano-concave lens of the same glass, the principal focal length is equal to twice the radius of curvature. In these respects the concave and convex lenses agree, excepting that the focal length of concave lenses is negative. The formula for determining focal length of concave lenses is $\frac{1}{f} = \frac{1}{p} - \frac{1}{p'}$.

(10924) W. E. F. asks: What would be the apparatus necessary to charge a storage battery from a trolley wire of an electric railway, and what size battery for 5 horse-power motor to run say 10 hours; and about what would the outfit cost, and how long would it take to charge it? A. You will require half as many storage cells to run your motor as the volts taken by the motor, since each cell will give 2 volts. To obtain the number of amperes you will need, divide 746 by the voltage of the motor. This gives the amperes for one horse-power hour. Multiply this by 5 and by 10, and you will have the ampere hours required for 5 horse-power for 10 hours.

(10925) C. C. McC. asks: Do you publish a work on the construction of voltmeters and ammeters that would enable one to construct one for use on an isolated plant? A. SUPPLEMENT No. 1215, price ten cents, will give information for the construction of a voltmeter and ammeter which may answer your purpose.

(10926) W. H. G. asks: 1. Please give acid used in pole indicator and ground detector and state what size and kind of wire is used. A. Make a solution of alcohol, 10 cubic centimeters, phenolphthalein, 1 gramme. Add to this distilled water, 110 cubic centimeters. Make a second solution of sodium sulphate, 20 grammes, in 100 cubic centimeters of water. Soak blotting paper in the first solution, and drain off the superfluous liquid. Then soak the paper in the second solution and dry the paper. To test the poles of an open circuit, moisten a strip of the paper, and place the ends of the wires about two inches apart upon it. A red spot will appear around the end of the negative wire. 2. Is there any way in which a bipolar dynamo can be made to give a steady current and not an alternating current? I cannot run a Ruhmkorff coil because of this, and would like to know if there is any instrument or battery that I can connect in circuit to stop this alternation? A. A dynamo gives a direct or continuous current when its armature is provided with a commutator. The same machine gives an alternating current when its armature is fitted with rings connected to the windings. Either form of dynamo will work a Ruhmkorff coil equally well. If the alternating current is to be used, screw down the vibrator so that it will not vibrate. 3. Do I understand that in the system of wireless telegraphy explained in SCIENTIFIC AMERICAN of January 4, 1902, there is no Ruhmkorff coil used in the transmitting part, but just the batteries connected to the earth? A. Yes; but Hertzian waves are not used in this system. 4. What are inductance coils, and please give an idea of how made? What is a choke coil and how made? A. An inductance or a choking coil is a coil to reduce the current by its induction upon the current as it passes through it. A second current is set up in the inductance coil, which flows in the opposite direction to the main current and thus chokes it off, so to speak. 5. Please give number of SUPPLEMENT, if you have same, that has plans and working drawings for constructing small gasoline motor. A. See SUPPLEMENTS Nos. 715 and 716, for construction of gas engines, 23 figures, 10 cents by mail. Also a book on "Gas Engine Construction," by Parsell and Weed, $2.50 by mail.

(10927) D. A. H. asks: Have scientists generally accepted the theory that the electric current does not flow through a wire, but follows the space around it? A. An electric current flowing with unvarying intensity flows through the material of the wire, flows in the wire, and also sets up a magnetic field around the wire. In this field a magnet is attracted by the lines of magnetic force. When an electric current flows with a varying intensity, either increasing or diminishing in intensity, as, for instance, starting with a sudden rush and as suddenly dying out, then electric waves are thrown off into the space around the wire, it may be with great force, so that they are sent many miles. It is these waves which are used in wireless telegraphy. They are not in the wire. The wire is but a core or center around which the waves whirl with tremendous energy. We are but beginning to learn their power and value, and have not yet harnessed them and broken them into our use and service. 2. Referring to the article entitled "Humidity and Heating Systems" in your SCIENTIFIC AMERICAN, why is it that the humidity of the air in the house heated by artificial means is so much less than that outside? Does the air lose any of its moisture by being drawn into the house and heated? A. The humidity spoken of is not the amount of moisture in the air, but the percentage of moisture as compared with the total amount of moisture which the air could hold at that temperature. Air saturated with moisture is said to have 100 per cent of humidity. The whole name is relative humidity, which expresses the meaning better. It is the moisture relatively to complete saturation. Now, the capacity of the air to hold moisture varies greatly with the temperature. In a summer morning fog may lie thick over the earth, because the air was saturated with

moisture, and the excess of water appeared as fog. The sun rises, warms the air and the fog disappears. Why? Not because there is any less moisture in the air than earlier, for the dew and fog will come again at nightfall and last till morning probably; but because at the higher temperature of midday the air can carry more water in the condition of invisible vapor than it could at the lower temperature of the early morning. Now apply this principle to the heated room. The air inside the room is warmer than the air out of doors; and though it may contain the same number of grains of water vapor to the cubic foot, that amount of water vapor will not bring the relative humidity of the room as high as it will the out-of-door air, because it will take more water to produce the same per cent of humidity in warm than in cold air. The warm air has a greater capacity for water vapor than cold air has. It is for this reason that we should have a water pan in the hot-air box of the furnace and add water vapor to the heated air before it enters the room.

(10928) H. L. P. asks: Will you kindly publish in your query column a list of all the different kinds of ether waves, their rate of vibration per second, and their wave lengths, and do they all travel at the rate of 186,000 miles per second? A. The ether waves concerning which you inquire are the vehicle by which the radiations pass from the sun to the earth. These radiations become heat, light, or electro-magnetism, and other forces perhaps, when they strike upon organs which can appropriate them as such. That which strikes the eye becomes light, that which affects other nerves of sensation gives us the sensation of heat. You will find much about these matters in Thompson's "Light, Visible and Invisible." So far as we know, all these waves pass through space with the same velocity, about 186,000 miles per second. We can send you the book named for $2.

(10929) E. S. asks: Can you tell me what material, fluid, solid, or otherwise, will retain its heat the longest, or where can I get a table of materials that are the best non-conductors of heat, and also what material or composition which when heated will retain its heat the longest, fluid, solid, or otherwise? A. We are not able to say what material will retain its heat the longest, but Kent in his "Mechanical Engineer's Pocket Book," which we will send for $5, gives a table of many materials with figures for each. In this table the radiating power of lampblack is taken as 100. On this scale polished iron is about 25, and polished silver and gold are only 3; so that of the materials which Kent names, polished silver and gold retain their heat the longest. All substances give off their heat much faster when rough than when polished. All liquids and gases are good non-conductors of heat. So too are numerous solids, such as asbestos, all woods, and many solids. It would not be possible to select one and say it is the best non-conductor of heat. Kent gives several tables on this point. The retention of heat and the conduction of heat are two totally different matters, and materials will be classified very differently in relation to the two qualities.

(10930) H. M. asks: 1. Could not the core of an induction coil be made longer and the secondary coil be placed beside the primary coil and not over it, and thus save considerable length of wire, and also number of turns of wire in secondary? A. Induction coils have been made with almost every possible relation of the various parts, with the result that it is a general agreement of experimenters that the usual mode of arranging is the best. The secondary coil is sometimes placed by the side of the primary in the transforming of alternating currents for lighting, but then the core is especially designed to save the lines of force. In coils for giving sparks the core should not be unnecessarily long, since the object is to secure as sudden a demagnetization of the core as possible. You would better conform to the proportions of coils as given in the best books. Take Norrie's "Induction Coils" for a guide. We can furnish it for $1. 2. Do the outer coils of the secondary add as much strength to the coil as do the turns of wire wound nearest the core? A. The outer turns of secondary wire have not the same value in producing current as do the turns near the primary. The mode of securing a small-sized secondary is to use the finest possible wire. No. 36 to 40 is employed. 3. How is the magnetic resistance of a piece of iron calculated? If I know the ampere turns how may I know the strength of the magnet? A. The magnetic resistance, or reluctance, as it is called, is equal to the length of the circuit divided by the product of the permeability by the area of cross section of the iron. The tractive power of a magnet in pounds is found by the formula,

$$\text{Pounds} = \frac{TC \cdot M \cdot \sqrt{A}}{2661\ L}$$

in which TC is the ampere turns, M is the permeability. A is the area of cross section of poles, and L is the mean length of magnetic circuit. 4. What voltage will a five-bar telephone generator furnish? A. The ordinary telephone generator will give from 65 to 75 volts. What a five-bar generator gives we are not able to say. 5. Why is it that a generator requires more power to turn its armature when delivering heavy current than when on open circuit? A. The generator requires more power to drive its armature when it is delivering current because it is then doing work. An engine running free does not require much power, but when heavy machinery is connected to it, it requires much steam to drive it. 6. Can you give me the formula for constructing a tangent galvanometer so that certain degrees deflection will equal certain value of current? A. A deflection of a certain number of degrees always represents the same current in a given tangent galvanometer. You do not require any special formula to determine the current for any deflection. Use the ordinary formula for the tangent galvanometer, and substitute the natural tangents for tangent a in the formula. Calculate the corresponding current in each case. Form a table of these currents for each angle, and keep it for reference. You will then save the trouble and labor of making the calculation for each reading; we mail you a copy of our Supplement Catalogue, in which you will find mention of articles on the construction of galvanometers.

(10931) E. S. asks: Will you kindly give me the scientific reason for the hour before dawn being the darkest and coldest, particularly the former? A. We do not know any scientific reason for the belief among people that the hour before dawn is the coldest and darkest. The popular proverb is, "It is always darkest just before dawn," which we always understood to refer to the mental attitude of a man who is hard pressed and finds help. The coldest hour of the night is found to be from 3 to 4 A. M. The darkest hour is when the sun is furthest below the horizon, or midnight. We do not see any other scientific conclusion. All daylight is gone from the atmosphere after the sun is 18 deg. vertically below the horizon, the time which marks the end of twilight of evening and the beginning of the morning twilight. Between these two times it is deep night and there is no reason why one of the hours should be darker than another.

(10932) W. A. P. asks: I am building a 12-inch spark coil according to Allsop directions. What test can I make to find if I have a good or perfect condenser? If I put 250 volts 1 lamp in series across the foil ends I get no trace of leakage or short circuit, but 110 alternating lamp series does not light the lamp, but there is a big leakage—so much that it cannot be held in the hand. I refer to using the condenser only, as the coil has not yet been built. I have 20 sections secondary built on the primary and receive only ⅜-inch spark with or without condenser, the maximum number being 96 sections. Does this appear right? A. The leakage of a condenser is found by charging it and discharging it immediately, then charging it and leaving it for say 15 minutes and discharging it again. The ratio of the discharge gives the leakage. There is no way of finding the leakage without proper instruments to measure with. We do not see any proof of leakage in what you write, though what you say is not clear. If you mean that a direct current of 220 volts shows no leakage, while with an alternating current 110 volts gives effects across the condenser, we reply that an alternating current does not charge a condenser at all. A condenser is not used on a coil when the alternating current is used with it. Without instruments or means of measuring the condenser you should make sure of each sheet of the paper, make the condenser as well as possible and rely upon the thoroughness of your work.

(10933) A. L. R. asks: 1. In running levels for a waterway of considerable length, like the Panama Canal, is not the rotundity of the earth an important factor that must be considered? A. In running levels for waterways of considerable length the line which is actually run is substantially a circle whose center is the center of the earth. The sights taken by the instrument between successive settings are so short that the curvature of the earth does not appreciably affect them, and at each new setting of the instrument the line of the level is parallel to the circumference of the earth at that point. 2. If it were possible to stretch a wire, perfectly taut, across a lake ten miles in width, so that it is perfectly level and absolutely without sag, would it not be necessary that the shore end of the wire be anchored at an elevation of not less than 16 2-3 feet above the water to prevent the immersion of the wire at the center of the lake? A. If it were possible to pass a perfectly straight line across a lake ten miles in width, the anchors must be elevated not less than 16 2-3 feet above the water to prevent the line from going below the level of the water at the center. 3. An extensive and perfectly level plain is traversed by a range of mountains; to pierce which, for a railroad, requires a tunnel ten miles in length. If such a tunnel is excavated with a floor perfectly level, as indicated by the surveyors' level or by "tees" placed at both ends and the center, assuming the possibility of sighting that distance, would not the center of the tunnel be lower than either end or than the plain outside, and would not the water in the tunnel drain toward the center? Would the specific gravity of an object placed in the center of the tunnel be affected by the superincumbent weight of the mountain mass? A. If the tunnel which you mention were to pierce a range of mountains ten miles long, it would not go in a straight line with the mountain, but be an arc of a circle whose center was the center of the earth, or else, as a matter of good engineering practice, it would be enough higher in the center, than indicated in the above statement, to allow drainage in both directions. If such a tunnel were excavated with a surveyor's level stationed at the point where the range of mountains left the level plain on one side, it would come out on the other side of the mountain range 65 feet above the plain. If the tunnel were excavated in an exact straight line from the plain of one side to the plain on the other, at the entrance of the tunnel on either side there would be a down grade of 65 feet in ten miles, or 6½ feet to the mile. The tunnel would be level in the center, and would be at that point 16 2-3 feet below the surface of the plain. The specific gravity of an object placed at the center of the tunnel would be slightly less than outside on the plain, because of the influence of the mountain.

(10934) W. B. asks: 1. A chicken gains about twice in weight for the first twenty-four hours after hatching. What do they live on, as they do not eat anything? A. It is true that chicks can go for several days without food, as there is sufficient of the egg left in the stomach to supply nutriment. They will eat on the first day, however, if food is provided. Chicks almost double in size the first day, owing to the organs being relieved from the compression of the eggshell, and as the down on the chick dries, it fluffs out and adds to the apparent size. It may be that in individual instances they double weight, but it is far from true as a general rule. We have known cases where the reverse was true. Where too much moisture has been kept in the incubator, the egg does not dry down enough, and the chicks hatch in a swollen, puffy condition. During the first day the surplus water in them evaporates, so that they shrink, and weigh less than when they were hatched. It may be true, too, that when there has been too little moisture in the incubator, and the eggs have been dried down too much, the chick will absorb moisture after being hatched and so increase in weight. Where the chick has been hatched under a hen, or where the conditions of moisture have been kept just right in the incubator, there will be very little, if any, change in weight during the first day. 2. A hard-boiled egg weighs quite a bit more than a raw egg. Where does it get the extra weight? A. The shell of an egg is very porous, and moisture and air also pass through it without difficulty. Hence in boiling water is absorbed by the egg, and this increases the weight of the egg. 3. Why does sap run up the tree? A. Sap is carried up a tree by osmotic pressure and capillarity, chiefly. The evaporation from the leaves tends to assist the flow during the season when the leaves are on the trees. These matters are explained in textbooks of physics.

(10935) H. H. A. asks: Kindly answer the following question: Does the date change between points on opposite sides of the 180 deg. meridian, or is it merely nautical reckoning that recognizes the date line? A. The date changes at any place when the line or meridian of midnight passes over that place. The date is constantly changing all the way around the earth during the twenty-four hours of any day. The international date line is a line which is very nearly coincident with the 180th meridian. To the east of that line the date is always one day later than on the west of that line. Night covers half of the world all the time. The meridian through the middle of the night is moving all the time around the earth. On the east of that meridian there is one day, on the west of that meridian there is another. A day is dying on the west side of that meridian, a new day is coming on the east. At eleven at night in your place, the line of midnight is one hour to the east of you. The day has one hour left. The next day is only one hour away to the east. In an hour it has reached you and passes over your head, speeding west ceaselessly, around and around the earth. However, when a ship passes the 180th meridian, it changes its date, since it has passed out of one day into another.

(10936) J. M. C. says: I am making an armature core, and after cutting out about one hundred disks, I thought that may be the iron (?) I am using is not free from steel. I send you three pieces. Examine them, and write me as soon as possible if they are all right. I have an equal number of all three grades cut. No one here can give me a decided answer as to their being strictly iron. Would it make so much difference if there was a little steel in them? The three are all species I can find here except tin. Is tin good for disks? A. Any one of the three pieces of sheet steel you send will answer for the armature core of a dynamo. The piece marked 3 is thinner and softer than the others and will be better, since more disks can be got into the same space. You cannot get sheet iron nowadays very easily. Steel has crowded it out of the market. As you may know, steel differs from iron in having a small per cent of carbon in it. It is iron with carbon, not a different substance.

(10937) C. S. W. asks: It takes several years for light from the sun to reach the earth; the light we now see started from the sun years ago. If the sun's light were extinguished, would we continue to get sunlight for as long time as it takes the light to reach the earth? On this theory, does an eclipse occur at the time we see it, or is it only the result that we see several years after the eclipse takes place? A. It requires 499 seconds for the light to come from the sun to the earth, and about one and one-third seconds to come from the moon to us. Hence, if the moon intercepts the light of the sun, we see the fact in one and one-third seconds after it happens. Whatever occurs on a distant star to affect its light, we see at such a time after it occurs as may be required for the light to pass over the space between us and that star. Anything that occurs on the sun is seen by us 8 minutes and 19 seconds after it occurs.

(10938) M. J. McC. asks: Does the part of a wagon wheel touching the ground while in motion stop while the other part of the outer rim of the wheel revolves, or do all parts of the outer rim revolve at the same velocity? I have heard this argued, but I confess I can't see how one part of the wheel could be in motion while the other was stationary. A. The part of the rim of a wagon wheel which is in contact with the ground is at rest while the rest of the wheel moves along in the direction in which the wagon is traveling, and the whole wheel moves around a line drawn through the center of the axle. Both statements are facts. We might add to this curiosity of motion that the top of the rim of the wheel moves forward in the direction in which the wagon is going twice as fast as the hub of the wheel moves. To understand the matter it is necessary to distinguish kinds of motion. The wheel has two certainly. It moves with a rolling motion over the earth; it rotates on its axle. Its motion of rotation as viewed by a fly which might be standing on one of the spokes is a continuous motion round and round, always repeating itself. The motion along the ground is of another kind. If a fly stood on the ground as the wheel passed by him, he would see a point of the rim come down to his side and stop. It would immediately begin to rise, and would go up high in the air only to descend again, and so on again and again. A point of a wheel in contact with the earth is not in motion with reference to the point of the earth on which it is pressing unless it is slipping backward, a condition which this case does not include. It is at rest therefore on the ground, but in motion around its hub or axle. Rest and motion are frequently relative. To some point a body may be at rest. To some other point it may be in motion. And it is sometimes quite puzzling to determine the rest and motion as it may be in reality. This is the case with some of the motions of the heavenly bodies. The motion of a wheel may be tested by taking a small circular disk and fastening a chalk crayon in a hole close to its edge. Then roll it along a fence in such a way that the chalk will mark a line on the boards. You will be interested in seeing its real path. You will see that it contains a point of rest. The curve traced by the crayon is called a cycloid.

(10939) W. B. C. says: Will you kindly state in your notes and queries column a process for treating wood for open fireplaces so that it will burn with colored flame? Also the substances used to make a slow-burning colored fire? A. In a pail of water put 4 ounces copper chloride, and soak the wood in this solution. When dry it will burn with a green flame. Zinc chloride and strontium chloride may be added, giving bluish and red flames mixed with the green. A slow-burning green fire may be made by mixing potassium chlorate 36 parts, barium nitrate 40 parts, and sulphur 24 parts. For a red flame use potassium chlorate 40 parts, strontium nitrate 39 parts, sulphur 18 parts, lampblack 3 parts. These formulas are from the "Scientific American Cyclopedia of Receipts," which contains many others, besides thousands of valuable receipts. We send it for $5.

(10940) C. A. G. asks: A D and C B are parallel horizontal planes, X is a 40-65 Winchester rifle. The distance A C is one foot and is vertical. Now a bullet is shot from the gun X, and the instant the bullet passes point A, another bullet (same size, etc.) is dropped from this same point, i. e., A. Will both bullets strike the ground within one-tenth of a second of each other? Besides answering this question, I wish you would give me the data from which you derive your answer. A. Both bullets in the case proposed will strike the level plane below at the same instant, not within a tenth second of each other. The reason is that the bullet which is shot from the gun falls by gravity as readily and as much as one which is dropped from the same point at the same time. The law of motion which covers this case is stated as follows: "A given force produces the same effect whether it acts upon a body at rest or in motion, whether it acts alone or at the same time as other forces." One force acts in the line AC, gravity; two forces act upon the ball which is shot from the gun, the force of the powder and gravity, to cause it to pursue the path AB in the same time as the other ball passes through AC.

(10941) G. W. S. says: Assume an air-pipe of considerable length, say 100 feet, open at its ends. Apply an air-pump of 10 pounds force at one end. Air will pass through the pipe because of a pressure at the inlet of 25 pounds against 15 pounds pressure at the outlet. Transfer the pump to the other end of the pipe, and use it as a suction pump.

Again air will pass, in the same direction, due to a pressure at the inlet of 15 pounds and an outlet pressure of 10 pounds. The latter arrangement is alleged to be the more efficient. Why so, since in each case apparently the actual moving force is the superior pressure at the inlet end, and there is the same difference of pressure at the ends? If there is no difference in efficiency, wherein lies the acknowledged great economy in an exhaust steam heating system, wherein a suction pump is placed at the tail of the system, as against a force pump of the same power placed at the head of the system and supplementing the power of the exhaust piston? Apparently here also the actual moving force in each case is a "push." A steam heating book uses the simile of pushing and pulling a rope—apparently an inaccurate one. A. There is no difference in efficiency between pumping air through a pipe and drawing it through by suction. The work required to move the same quantity of air at the same velocity will be the same in either case. The idea that you have regarding the greater efficiency of a vacuum steam-heating system is correct, but for a very different reason. The great difficulty with steam-heating systems is that air gets into the pipes and radiators, and is difficult to dislodge by the circulation of steam under pressure. By means of an air pump, producing a slight vacuum in the entire system, however, there is no difficulty in keeping the system free from air, and having every part of the heating surface effective.

(10942) C. M. H. asks: Could you give me simple method for treating cloth or paper for making a barometer, the kind that changes color—pink for rain, blue for fair? A. A formula which recently appeared for the so-called color barometer is as follows: Cobalt chloride, 30 parts; sodium chloride, 15 parts; calcium chloride, 4.5 parts; gum arabic, 7.5 parts; water, 45 parts. Soak cloth in this solution and dry. The solution absorbs moisture from the air, and so changes color. The cobalt chloride is the substance which changes color by moisture. The cloth is not a barometer in any proper sense, but a hygrometer, since it shows the presence of moisture in the air, and not the pressure of the air.

(10943) A. B. asks: 1. Can you tell me of a simple test to tell platinum wire? A. Platinum is characterized by its high fusing point, about 3450 deg. Fahrenheit. It cannot be melted by any temperature below that of the oxyhydrogen flame. This is the simplest test. Heating in an ordinary flame does not alter it. It is not soluble in any single acid, but is dissolved by aqua regia. 2. Is it true that there is a salt lake that has a crust of salt on the surface? If so, what is the name of it? A. There is a place called Salton in California where salt is plowed up from the surface of the shore of a lake and purified for the market. Later another crop can be harvested from the same place. Salt does not float on water. There cannot be a crust of salt over the surface of a lake. 3. Why is it that ice is a non-conductor and water is a conductor of electricity? A. Neither ice nor water when pure is a conductor of electricity. Water owes its conductivity to minute quantities of impurity in it. Ice tends to freeze itself pure from impure water. Hence ice is usually a non-conductor of electricity. A. Can you explain to me what watt and watt-hours denote? A. A watt is the unit of electrical power. One ampere flowing at a pressure of one volt gives power of one watt. One watt working for one hour makes a watt-hour. You would find all such questions answered in Swoope's "Elementary Lessons in Electricity," which we can send for $2.

(10944) H. O. N. asks: There has been quite a bit of discussion here on this subject, and I write to you so that I may help it along. Which goes the faster—the top of a wagon wheel or the bottom? What would be the center of it in that case? Is a wheel that is on the ground any different than a pulley in the same case? Some say that the top goes twice as fast as the axle, and that the bottom stands still. A. The discussion about the "going" of a wagon wheel turns wholly upon the use of the word "go." Define going, and all will become clear. A wheel *goes* with reference to the axle in one manner and with reference to the ground in quite another manner. Going may then be rotating or moving along. It rotates around the axle. All parts rotate alike, going around at the same speed, that is, going around in the same time, each point in its own proper circle. The whole wheel moves along with the axle over the road at the same speed as the axle and, for that matter, at the same speed as the whole wagon moves over the road. This being settled, it remains to inquire how the parts of the wheel move with reference to a point on the ground past which the wheel may be "going." Consider a point just in front of the wheel. As it approaches this point the tire, or rather a point on the tire, comes down and rests for a moment on this point of the ground. It is not in motion on that point if there is no slip of the wheel on the ground. This is what is meant by saying that the bottom of a wheel "stands still." It is at rest on the ground underneath the wheel for an instant. At the next instant that point of the tire begins to rise from the ground, and goes on up till it reaches the top of the wheel. The motion is a very curious motion, as you can see by marking a point on the tire of a wheel and watching its path as it comes down to the ground and rises again to the top of the wheel. It describes the curve called a "cycloid." Now when the point of the tire is at rest on the ground, the axle does not stop. It moves right on, and so does the top of the wheel. As the top of the wheel is twice as far from the ground as the axle is, it will be seen that the top of the wheel must be moving along two times as fast as the axle is moving. This can be seen in another way. Take a point on the rim which is at the same level as the axle and is behind the axle. As the wheel rolls along the road this point goes up and over and comes down to the front of the wheel and to the same level as the axle. It has gained on the axle the whole diameter of the wheel. It was behind and now is in front of the axle. To do this it must have moved faster than the axle over the road. See if you can calculate how much faster. During the next half turn of the wheel this point drops down to the ground, rises again to the same level, and is behind the axle, by the whole diameter of the wheel. It has lost distance, and has gone over less space than the axle of the wheel went over in this half turn. See if you can calculate how much less distance it has gone over. You will find that there is just as much distance lost as there was distance gained when the point was on the upper part of the wheel. There is more of curious interest in the rotation of a wagon wheel than your questions implied. Most of the differences of opinion in discussion would be removed by a careful definition of the terms employed and a careful statement of the conditions of the case which is under discussion. There are many hot discussions in which both sides mean the same thing, but use words in different senses in expressing their meanings. Probably this is the case with your discussion.

(10945) S. T. B. asks: 1. I have read that in the secondary coils of induction coils there is sometimes a current of 30,000 volts with as low as 0.001 ampere. To me this seems to conflict with Ohm's law. To put it at a safe figure, the resistance of the secondary coil of such an instrument would not be more than 500 ohms. Then if we divide volts by ohms according to Ohm's law, we would get 60 amperes. This I can plainly see would be impossible, but please point out my mistake in reasoning. A. We do not see any reason why Ohm's law should not be applied to any case of volts and amperes to find resistance. No correct result can be impossible. It is, however, not to be supposed that the resistance in the case given is that of the secondary coil alone. It is that of the coil and the air for the spark length, whatever that was. Even when air is ionized, several inches of it has a high resistance. Nor is the resistance of a secondary coil likely to be as low as 500 ohms. No. 36 wire B. & S. has 2.4 feet per ohm, and 500 ohms would be only 1,200 feet, while a large coil giving a 12-inch spark would require at least 17 miles of such wire, with a resistance of 18,270 ohms. Spottiswoode's great coil had 280 miles of wire in its secondary; but that is more than is required for the same spark length nowadays. There are two errors in your note, one in underestimating the amount of wire used in secondaries and another in neglecting the air resistance as a factor in cutting down the amperes required in a secondary coil for a given voltage. Now again the self-induction at the moment of breaking the primary circuit causes a tremendous inductive effect upon the turns of the secondary, with the result that a tremendous voltage is produced in the secondary coil. This rises enormously above 30,000 volts when the spark distance is large. A table recently issued shows that 20,000 volts are required to throw a spark 1 inch between sharp points in the air; while to throw a spark 15 inches, 150,000 volts are required. Now coils have been made to throw 45 inches. 2. How does magnetism interfere with the working of a watch? A. The magnetism of the steel parts of a watch affects the motion of the hairspring and balance wheel when that is of steel or has steel balancing parts upon it. 3. Have diamonds ever been produced artificially? A. Diamonds have been made artificially by Moissan in his electric furnace experiments, and they have been found in meteorites. See Moissan's "Electric Furnace," page 77.

(10946) W. R. M. asks: I am puzzled over a problem in electricity. Here it is: What number of volts and amperes will light a 12-watt electric lamp?

1 volt	× 12	amperes	= 12 watts
2 volts	× 6	amperes	= 12 watts
3 volts	× 4	amperes	= 12 watts
4 volts	× 3	amperes	= 12 watts
6 volts	× 2	amperes	= 12 watts
12 volts	× 1	amperes	= 12 watts
24 volts	× ½	ampere	= 12 watts

You see the products are all the same from the multiplication of the volts × amperes. Please explain about the lamp and voltage and amperage. A. We do not see any puzzle about your problem. You show that there can be seven different ways of dividing the volts and amperes so that the lamp will have 12 watts. There is no puzzle about that. It is quite true. The only question is, which would be the better way to divide the volts and the amperes. We would decide that to be either the 6 volts and 2 amperes, or the 12 volts and 1 ampere, or 24 volts and ½ ampere. The higher the voltage the smaller the wire necessary to carry the current without overheating the wire, and so the cheaper the wiring will be.

(10947) C. B. R. writes: What controls the circulation of elaborated sap of trees? Why does, or does, it rise in the spring? Or where does it come from? At what time each month can a bush having sugar in its roots be cut so that it will sprout and grow? At what time each month will it die if cut? What stops the circulation or keeps it back from the roots at times? Why should freezing the ground make a free flow of sap, and no frost a moderate flow? Why when a board or straw is laid on the ground at certain times, it will settle down, at other times it will rise? A. The rise of water in trees from the root tips to outermost twig is a strange thing, and its mechanics is not even yet clear. Capillarity plays a part, as also does osmotic pressure. The power of living protoplasm to imbibe water was once thought to explain it. Again, others have thought that the evaporation from the leaf surfaces causes the water below to rise as if drawn up by pulling on the end of a filament of water. All these and perhaps other and undiscovered causes may be at work to raise the water sometimes hundreds of feet. The water rises most easily in the new wood, and this is formed in the early summer or late spring. We do not believe that the time of the month has anything to do with the sprouting of seeds or the growing of sprouts. This is an old superstition connected with the moon, which dies hard. If a twig is cut off, the power of growth in the tree usually is sufficient in the early part of the year to produce other shoots to take its place in the support of the life of the tree. Late in the season these sprouts do not so readily appear. There are always buds in the bark which will grow if moisture is supplied to them. They may stay years without starting, and wounds given to the tree may then make them start to grow. Sap circulates freely till the ring of wood and new bark is formed and the walls of the cells have thickened so that water cannot easily pass through these walls. The flow is not then much. The season of growth is over for that year. The flow of sap out of a tree in which a hole has been made, as in the sugar maple, in early spring is due not to the freezing of the ground, as most suppose, but to the expansion of the water by the warmth of the sun during the day. The tree is gorged with sap, which is ready for the production of wood for the spring. The nights are cold, below the freezing point, the day is warm; the large difference of temperature expands the sap, and forces some of it out of any hole in its course up the tree. When this large fluctuation of temperature from the day to the night and back again ceases, the tree also ceases to give sap for sugar. We do not understand the question of the board laid on the ground and sometimes sinking and at others rising. We never saw or heard of that before.

(10948) C. K. B. asks: What is the cause, or where do the prevailing westerly winds of the northern hemisphere originate? How does the rotation of the earth cause the deflection of the trade and anti-trade winds of the northern hemisphere? A. The general systems of the winds are due to the greater heat of the torrid zone. This produces the inflow of air from the cooler regions on either side of the hot region. The heated and lighter air is forced up by the flowing of the colder air under it, and it flows away to the north and south in the upper layers of the air. After this air is cooled it descends, and flows along toward the poles, only to return and again take part in the general circulation of the winds. The rotation of the earth on its axis causes great changes in direction of these currents, and we have northeast and southwest winds as more or less permanent winds in different parts of the northern hemisphere. This is but a rough and general statement of the winds, but may serve as a basis for fuller reading on the subject in the physical geographies. As the current of cooler air flows along over the smooth surface of the ocean in the torrid zone north of the equator, it is passing from a region where the velocity of rotation of the earth is less to a place where it is greater. This causes the wind to lag with reference to the earth under it, and to appear to come from a point farther to the east than it has really come. It thus becomes a northeast wind, and is the northeast trades. For a similar reason the returning currents of air over the ocean become southwest winds, or the anti-trade winds.

(10949) L. K. asks: Will you kindly tell me through your valuable paper which way the compass points south of the equator—to the north or to the south pole? A. In both hemispheres the magnetic needle points to both poles, except for the declination of the needle. That the north end of a needle should point to the north pole necessitates that at the same instant the south end should point toward the south pole. Along the line of no magnetic declination this is actually the case. The needle points to true north and true south.

(10950) L. A. T. asks: Will genuine amber burn? A. Amber burns with a pale yellow flame, with a good deal of black smoke, evolving an agreeable odor, and leaving a black mass of carbon behind. As it is about 79 per cent carbon, and 10.5 per cent each of hydrogen and oxygen, it is evident that it must be combustible. We should infer the same fact from its origin. Amber is a fossil gum, partly soluble in alcohol and ether; since it frequently contains insects, it must have been a viscid liquid when these were entrapped to their destruction. Imitation amber may be made with the insects in place as in the genuine article, although in the genuine amber the insects are usually of extinct species. 2. Is there any imitation of amber that can be electrified, so that it will pick up bits of paper as amber will? A. Since most gums and resins can be electrified by rubbing, it is probable that imitations of amber may be electrified. 3. Kindly give me an infallible test by which the genuine articles can be identified. A. Amber contains nearly 90 per cent of a resin which resists all solvents, called succinite, and 2½ to 6 per cent of succinic acid. There are also two other resins soluble in alcohol and ether, besides an oil. The determination of these by analysis will determine the substance to be amber.

(10951) J. W. asks: 1. How is bicycle riding explained? By what laws does a man balance himself? A. A bicycle maintains its upright position upon the same principle that a pendulum maintains its plane of oscillation, or a rotating wheel maintains its plane of rotation. This is most clearly illustrated in the Foucault pendulum and the gyroscope. As long as the bicycle is moving, it will not fall over. 2. Scientists claim to find the shape of the earth by the pendulum. This would all be very well if the density of the earth were the same in all of its parts, but as that is very improbable, it seems to me that the results of these measurements are also very improbable. Is there any way of correcting these results? A. The time of vibration of a pendulum depends upon the intensity of gravity in the place where it is hung and swung. The variation in density of the earth is not great, and the mean density is known to sufficient accuracy. It is not probable that the results of pendulum measurements are greatly in error, or in error at all beyond the variations assigned as the limits of the determination. We have no better way to determine the form of the earth than by the pendulum, and measurements of meridians. 3. In looking over several cyclopedias for the article Parallax, I find that astronomers do not make any allowance for the motion through space of the solar system and of the star whose distance is to be measured. Do they really make any allowance for these motions? These motions certainly influence the parallax. A. The proper motions of some stars are known, and can be allowed for when these stars are observed. This is so little that it cannot affect the parallax to a sensible amount. The nearest star is 4 1-3 light years distant from us. The sun is 8 minutes and 19 seconds from us in terms of the velocity of light. The annual parallax of the nearest star is 75-100 of a second of arc; its distance is 25,000,000,000,000 miles. The variation of its parallax due to the motion of the sun in a year through space is not appreciable. 4. We are bothered here with alkali water. Is there any way of making such water drinkable? A. Without an accurate chemical analysis of your water, it is impossible for us to express any opinion. The question of the purification of drinking water is always a somewhat difficult one, and it seldom happens that impure water can be much improved without considerable trouble and expense. In case you have not tried it, however, we would suggest your boiling the water for a period of about twenty minutes. With some waters this will cause a sediment to form, which when allowed to settle, removes many of the impurities with it.

(10952) J. D. asks: Can you give me in your query department of your paper, data for a small jump-spark coil, such as is used on gasoline motor cycles to explode mixture? Using four dry batteries for the primary excitation. Writer has several pounds of No. 36 B. & S. silk-covered copper wire. Can this be used on secondary? A. A strong and reliable spark can be made for gas ignition with a coil of the following proportions: core length 7 inches, diameter ¾ inch, made of No. 20 iron wire, B. & S. gage. Primary of three layers of No. 14 copper magnet wire, cotton covered. Secondary 1 pound No. 36 silk-covered wire. Condenser of forty sheets of tinfoil, 4 x 6 inches. The insulation of the secondary should be very carefully attended to. Failure here will cause a loss of the whole. The details of the work are given with great fullness in Norrie's "Induction Coils," which we can send you for $1.

(10953) A. A. B. asks: I wish to ask through your paper if it is not possible for the manufacturers of incandescent light bulbs to complete the bulb without having to form the little sharp point on the rounded end? A. Incandescent lamp bulbs are made without any point upon the large end. They may be had from dealers in electric supplies.

(10954) L. A. H. asks: Is there such a thing in the realm of science as flame or combustion without emitting light? A. Combustion is usually the combination of a substance with oxygen. This may take place with rapidity, so that much heat is produced, and also light; but often it takes place so slowly that no light is seen, and the temperature may not rise very much above that of the air. The rusting of iron or steel is an example of this.

(10955) F. W. B. asks: 1. Please give (in substance) an explanation of the phenomena of rotating storms, such as whirlwinds, cyclones, etc. Do they always rotate in one direction, and why? A. The rotation of storms is caused by the rotation of the earth on its axis. In the northern hemisphere these storms rotate in a direction opposite to the motion of the hands of a clock; in the southern hemisphere they turn with the hands of a clock. All cyclones, hurricanes, tornadoes, etc., follow the same law. 2. Is it possible for a whirlwind to rotate for a time in one direction, and then reverse and whirl in the opposite? I ask this last especially for the reason that two reputable persons of my acquaintance claim to have seen this phenomenon. A. Small whirlwinds, such as form in a field or at a street corner, probably turn in either direction; but if one was seen to rotate one way, and in a brief time another was seen in the same place turning in the opposite direction, we should consider that these were two different whirlwinds, and not a whirlwind which had reversed itself.

NEW BOOKS, ETC.

We have received from Knowledge, 27 Chancery Lane, London, W. C., a circular slide rule devised by Major B. Baden-Powell. The instrument consists of two similarly figured dials, an outer fixed one and an inner rotatable one. These are graduated in logarithmic sequence, and the numbers are arranged in spirals, so that the decimals coincide, as in all slide rules. While not professing to be an absolutely exact calculating machine, this simple appliance ought to prove of the greatest use in everyday life. It is so simple in action, so compact, and yet so reliable, that it should find a place on the writing table of all those who have frequent calculations to make. Not only does it enable one very rapidly to obtain approximate results, even with large figures, in multiplication and division, but for those who have to deal with foreign measures and wish to know, almost at a glance, the equivalent in English measures, this should prove helpful. One advantage of this form of apparatus may be noted, that any special measures which have to be converted, such as rubles to pounds, carats to grains, or kilowatts to horse-power, can be temporarily marked on the card. The equivalent fractions of decimals, proportions, and square roots are also easily found.

THE MODIFICATION OF ILLINOIS COAL BY LOW TEMPERATURE DISTILLATION. By S. W. Parr and C. K. Francis. University of Illinois Engineering Experiment Station. Urbana, Ill.: Published by the University. 8vo.; Pp. 48.

The details of this paper are many and intricate, and the conclusions rather vague and unimportant. The main conclusion appears to be that coal can be made more available for certain purposes by treatment, but neither the cost of the treatment nor the total B.T.U. of the evolved gases is given. In fact, the research is incomplete and hardly ripe for presentation.

ELECTRICITY: WHAT IS IT? By W. Denham Verschoyle, M.E., M.I.M.E., M.A.I.M.E. London: Swan Sonnenschein & Co., Lim. New York: The Macmillan Company, 1908. 16mo.; cloth; 259 pages; illustrated. Price, $1.

A purely theoretical position has been taken by the author in discussing the question: What is electricity? In seeking the laws that regulate the intermediate action of energy and matter the finding of new facts has been subordinate to generalization through chapters on the gyron, atom, molecule, heat and light, electricity and magnetism, dissociation and devolution, and life. The importance of theoretical work in the new science as demonstrated in this volume may cause additional attention to be drawn to it when known that the tables and general conclusions have received a measure of confirmation in the work of Sir William Ramsay. Spectrum analysis is dealt with in the appendix.

CEMENT LABORATORY MANUAL. A Manual of Instructions for the Use of Students in Cement Laboratory Practice. By L. A. Waterbury, C.E. New York: John Wiley & Sons, 1908. 12mo.; 122 pages, 28 figures. Price, $1.

This manual has been prepared for the use of students taking the course in cement laboratory practice in the University of Illinois, and for the use of others who may have occasion to use such a laboratory manual. Instructions for the problems originally used in the course mentioned were devised by Ira O. Baker, professor of civil engineering, University of Illinois, under whose direction the author had charge of the cement laboratory at that institution for three years. This manual has been prepared by revising and extending the instructions already in use. The problems which are given herein are suitable to class use and are not intended to serve as instructions for the testing of cements for commercial purposes. However, the problems have been designed to include all of the tests which are ordinarily made, so that a student who shall have completed these problems should be able to do testing for commercial purposes, although the experience which is required for the production of uniformly satisfactory results in the latter class of work can be obtained only by a considerable amount of practice, and cannot be obtained to any considerable extent by a laboratory course which is intended chiefly to teach methods of testing.

ELEMENTS OF RAILROAD TRACK AND CONSTRUCTION. By Winter L. Wilson. New York: John Wiley & Sons, 1908. 12mo.; 320 pages, 181 figures. Price, $2.

In this volume no attempt has been made to treat the subjects of railroad track and construction with any considerable amount of detail, but rather to present a few of the fundamental principles in such manner that the inexperienced engineering student can form a general idea of the subjects. There are a number of excellent treatises on track which go into the subject with a wealth of detail and a thoroughness of discussion which is of immense value to the maintenance-of-way engineer with some experience; but, unfortunately, these books are not suitable for class-room work, both on account of the student not being able to appreciate the value of the details and also on account of the impossibility of reading these books in the time usually given to such subjects in an engineering course. Details of practice can be much more readily learned and appreciated from actual experience. There is not much time in the four years of an engineering course that can economically be given to the details of practice, but it is essential that the student should understand the fundamental principles of the subjects. In this volume some of the general principles of track and of the part of railroad construction with which the young engineer may come in contact early in his experience are presented.

HIGHWAY ENGINEERING. By Charles E. Morrison, A.M., C.E. New York: John Wiley & Sons, 1908. 8vo.; 315 pages, 60 figures. Price, $2.50.

This was prepared for the second-year students of the department of civil engineering at Columbia University, with a view to furnishing a test in which the fundamentals of the subject should not be buried in a mass of detail, such as is frequently found to be the case in works of a similar character. This book is, therefore, not a reference work, but rather one in which it has been the endeavor to outline and emphasize those basic principles which are essential to good highways.

THE ENGINEERS' DESCRIPTIVE CHARTS IN COLORS. Showing the Development of the Steam Boiler. Showing the Development of the Steam Engine. Showing the Development of the Electric Generator. By Joseph G. Branch, B.S., M.E., Author of Stationary Engines, Conversations on Electricity, etc. New York and Chicago: Rand, McNally & Co., 1908. 28½x22 inches; illustrated. Price, 50 cents each.

The charts are clearly illustrated and effectively printed in three colors. The development of the subjects is both technical and historical and the charts will prove to be an invaluable aid to all engineers, firemen, machinists, students, and electricians.

STEAM POWER PLANT ENGINEERING. By G. F. Gebhardt. New York: John Wiley & Sons, 1908. 8vo.; 816 pages, 461 figures. Price, $6.

This book is the outcome of a series of lectures delivered to the Senior class of the Armour Institute of Technology, Chicago, Ill. It is primarily intended as a text-book for engineering students, but, it is hoped, will also be of interest to practising engineers. The field embraced by the title is a large one and it has been necessary to limit the treatment to essential elements. Much of the matter contained in the author's original notes, including that relating to steam engine design, valve gears, steam boiler design, and the like, has therefore been omitted. The numerous references appearing throughout the text and the appended bibliographies, which have been carefully compiled, are depended upon to extend the scope of the work. The standard codes of the American Society of Mechanical Engineers for conducting engine and boiler trials are in frequent demand by engineers and have therefore been included as an appendix. Authorities have been freely consulted and extensive use made of current engineering literature, due acknowledgment being made by footnote or reference whenever possible. The matter included is representative of American practice and no effort has been made to include any other except in a few special cases.

LONG ODDS. By Harold Bindloss. Boston, 1908. 12mo.; 401 pages. Price, $1.50.

This latest and best book by this popular teller of tales is a story of splendid endeavor, the scene Portuguese West Africa. A promise to a dying partner sends the Quixotic hero out into the steaming jungle on an errand of freedom and into innumerable perils which thrill the imagination with the strange ways of the mysterious and fascinating Dark Continent. The vivid picture of the so-called contract labor conditions, which amount to Negro slavery, is of particular value to everyone interested in the Congo reform movement. There is an American missionary of fine heroism whose acquaintance every American will gladly make, and the absorbing love story holds the reader enthralled.

HERCULANEUM, PAST, PRESENT AND FUTURE. By Charles Waldstein, Litt. D., Ph.D., L.H.D., and Leonard Shoobridge, M.A. With Appendices. London and New York: The Macmillan Company, 1908. Illustrated. Imperial 8vo.; 324 pages. Price, $5.

Dr. Waldstein has written an exciting book, says the New York Tribune. Archæology has always had more romance about it than the prosaic layman has been prepared to admit, but in the present instance it makes a peculiarly alluring appeal. If it stirs the blood to think of what the excavator feels when he uncovers a single tomb in Egypt it is positively thrilling to contemplate the possibilities summed up in the name of that Campanian town which was buried by an eruption of Vesuvius in 79 A. D., and has been left almost undisturbed in its sleep ever since. There are reasons why we are justified in believing that Herculaneum, if fully uncovered, would yield treasures of art and other vestiges of the ancient past incomparably richer than those dug up at Pompeii. The Italian government has committed itself to excavate Herculaneum on its own responsibility. The work will necessarily be slow. It requires prodigious sums, which only the nations of the world, acting together, could supply. No better contribution could be made toward a movement culminating in such a scheme than is made in these pages. Obviously, excavation at Herculaneum should reveal innumerable objects for a few hundred to be found at Pompeii. Furthermore, the two towns suffered in distinctly different degrees from the malice of Vesuvius. Herculaneum is a mile and a quarter nearer than Pompeii to the foot of the volcano. Pompeii suffered enough in all conscience, but she got off with, on the whole, less damage. Now what happened at Herculaneum? With overwhelming suddenness a sea of liquid mud swept over the town and buried it to a depth of about eighty feet.

THE BOOK OF THE PANSY, VIOLA, AND VIOLET. By Howard H. Crane. New York: John Lane Company, 1908. 16mo.; 106 pp. Price, $1.

The beautiful flowers of the pansy, that we are now accustomed to see in nearly every garden worthy of the name, were not evolved in one short space of time. They are the outcome of many years of persistent effort on the part of a comparatively few enthusiasts, who, by dint of infinite patience and labor, have helped to evolve the glorious blooms that are now so largely grown. The pansy dates only from 1813. With careful breeding the pansy was evolved from the heart's-ease. The book deals with everthing relating to the pansy, the viola, and the violet.

LES NOUVEAUX LIVRES SCIENTIFIQUE ET INDUSTRIELS. Vol. I. Annees 1902 à 1907. Livraisons 1 à 20. Bibliographie des Ouvrages publiés en France. Du 1er Juillet, 1902, au Juin, 1907. 1° Table alphabétique des sujets traités. 2° Table alphabétique des noms d'auteurs. 3° Livraisons trimestrielles (Nos. 1 à 20). Paris: H. Dunod et E. Pinat, Editeurs, 1908.

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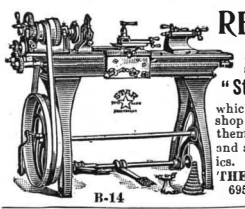

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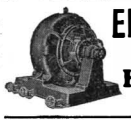

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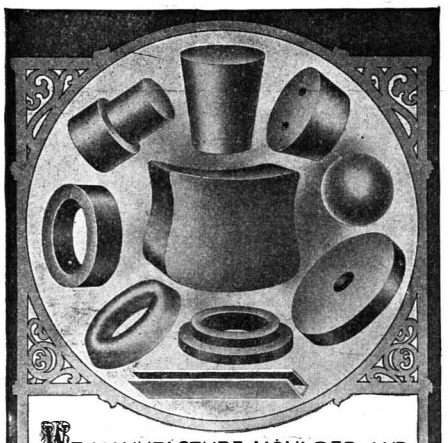

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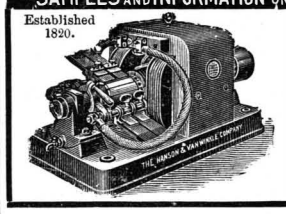

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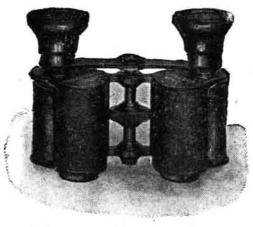

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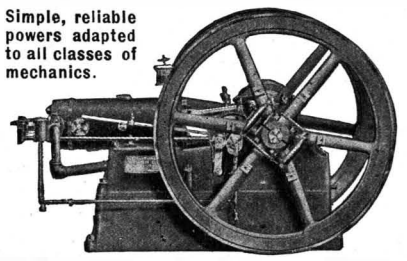

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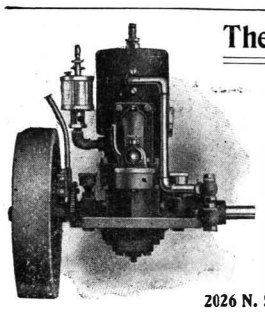

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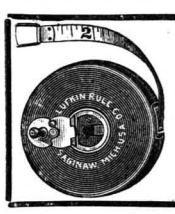

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